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EDITORIAL NOTES.

The Training of the Student of Medicine.

Of the many after-war problems that await solution by the medical profession, not the least important is that of the training of those who desire to enter it and to make the practice of medicine their career. When the time comes for works of reconstruction the teaching section of the profession must be ready to meet the heavy demands that will be made on it. To this end the Edinburgh Pathological Club have instituted an inquiry, the objects of which are to define clearly the aims of medical teaching, to adapt existing means to secure these aims, and to devise improvements called for by altered conditions.

In this issue we publish the first contributions made to this inquiry, which was opened by Sir James Mackenzie in an address delivered to a joint meeting of the Royal Medical Society and the Pathological Club.

Discussions have already taken place on the teaching of Chemistry, introduced by Professor James Walker; Physics, by Dr. C. G. Knott; Botany, by Professor Bayley Balfour; Zoology, by Professor Cossar Ewart and Dr. Ashworth; and Anatomy, by Professors Elliot Smith (Manchester), Waterston (St. Andrews), and Robinson (Edinburgh). Arrangements have been made to consider each subject of the curriculum, and we hope to publish the communications with a short *résumé* of the discussions in succeeding numbers of the *Journal*.

CASUALTIES.

Killed in action, Captain John Alston, M.C., R.A.M.C.

Captain Alston graduated M.B., Ch.B. at Glasgow University in 1916, after which he joined the R.A.M.C. special reserve. He was awarded the Military Cross in October 1917.

Died of wounds, Captain N. J. H. Gavin, M.C, R.A.M.C.

Captain Gavin graduated at Edinburgh University (M.B., Ch.B.) in 1904. He joined the R.A.M.C. two years ago, and in June 1917 he was awarded the Military Cross.

KILLED in action, Captain A. COWE, R.A.M.C.

Captain Cowe graduated at the University of Edinburgh in 1913, taking the degree of M.B., Ch.B. He was awarded a King Edward VII. British-German Studentship, and studied for a year at Freiburg in Germany.

KILLED in action, Captain GIDEON WALKER, M.C., R.A.M.C.

Captain Walker graduated M.B., Ch.B. at Edinburgh University in 1912, after which he acted as house surgeon in the Royal Infirmary. In November 1916 he was awarded the Military Cross.

DIED of wounds, Captain GEORGE HISLOP, R.A.M.C.

Captain Hislop graduated at the University of Glasgow in 1913, and in 1915 took a commission in the R.A.M.C.

DROWNED at sea, Dr. ALEXANDER JAMES THOMPSON SWANN.

Dr. Swann graduated at Glasgow University in 1898, taking the degree of M.B., C.M. In 1913 he took the D.P.H., and joined the West African Medical Service.

KILLED in action, Captain J. M. MATHESON, R.A.M.C.

Captain Matheson graduated M.B., Ch.B. at Glasgow University in 1916, and served, first in the Navy, and later with the Army in Mesopotamia and France.

MEDICAL STUDENTS.

KILLED, Lieutenant WILLIAM MICHAEL DASHWOOD STIRLING STRETTELL, R.F.C.

Lieutenant Strettell was a medical student at the University of St. Andrews before the war. In 1914 he took a commission in the Highland Light Infantry, and in 1915 he went to France. He was wounded at Ypres, and afterwards served with the Royal Scots in Egypt. He joined the Royal Flying Corps in 1916, and returned to France in 1917.

KILLED in action, Second-Lieutenant GAVIN HADDOW BOYD, King's Royal Rifles.

Lieutenant Boyd was a second-year's student of medicine in Glasgow University before joining the Army.

Royal College of Surgeons of Edinburgh.

THE following gentlemen, having passed the requisite examinations, have been admitted Fellows of the College:—Arthur Frederick Cole, M.R.C.S.(Eng.), L.R.C.P.(Lond.), Captain, R.A.M.C.; Subodhchandra Datta, M.B.(Calcutta Univ.), Calcutta; Sidney Forsdike, M.B., B.S.(Lond.), M.R.C.S., L.R.C.P., M.D., London; Joseph Geoghegan, M.B., Ch.B.(Edin.), Lieutenant, R.A.M.C.; William Moir Webster Shepherd, M.B., Ch.B.(Edin. Univ.), M.D., B.E.F.; Robert Tennent, M.B., Ch.B.(Glas. Univ.), temporary surgeon, Royal Navy; Nathan Judah Wigram, M.R.C.S.(Eng.), L.R.C.P.(Lond.), Captain, R.A.M.C.

Mr. David Percival Dalbreck Wilkie, F.R.C.S., has been awarded the Liston Victoria Jubilee Prize of £100 for his valuable work and contributions with reference to abdominal surgery.

CEREBRO-SPINAL FEVER.*

By P. W. MACLAGAN, M.D.

I.—INTRODUCTION.

THE material on which this thesis is based is very largely derived from the study of upwards of 400 cases of cerebro-spinal fever during the epidemic of 1914 to 1917. With very few exceptions, I have been responsible for the treatment of all of these cases.

In any comparison of the cases in the present series with those of past epidemics the great difference in age and sex incidence must always be kept in mind. All my cases occurred in adults, and with few exceptions in adult males who, a short time previously, had passed a medical examination as to their fitness for service with His Majesty's Forces.

Perhaps, on the whole, less objection can be raised to the name cerebro-spinal fever than to most that have been employed. The disease is certainly a general infection, and in the great majority of cases the most obvious symptoms are those due to infection of the central nervous system and its covering membranes.

HISTORICAL AND GEOGRAPHICAL SURVEY.

The earliest reference to epidemic meningitis is found in a description of a comparatively small group of cases which occurred in Geneva in 1805. Prior to this date the disease was either unknown or was not recognised as a separate entity. In any case, no description which will fit in with our knowledge of the disease can be found in the writings of physicians of earlier periods.

The earlier history of cerebro-spinal fever is described by Hirsch in his *Handbook of Historical and Geographical Pathology*, published in 1886, and that of the more recent epidemics in a report by Dr. Bruce Low to the Local Government Board, 1915. The present description is very largely taken from these sources. Hirsch divides the history of epidemic meningitis into four periods—(1) 1805 to 1830; (2) 1837 to 1850; (3) 1854 to 1876; (4) 1876 to 1884.

1. (1805 to 1830).—The epidemic in Geneva prevailed during

* Part of a thesis for which the degree of M.D., with a Gold Medal, was awarded by the University of Edinburgh, 1917.

the months of February, March, and April of 1805. Thirty cases occurred, and the post-mortem appearances in fatal cases were those of meningitis. The next appearance described occurred during the same months of 1814 amongst the soldiers of the garrisons of Paris and Grenoble. In the following year there was an outbreak of the disease at Metz and also in the province of Genoa. During the earlier months of 1822 considerable outbreaks occurred at Vesoul and later in the same year in Westphalia. During this period widespread epidemics occurred in the United States.

The disease first appeared in Canada in 1807, and apparently spread to the States of Virginia, Kentucky, and Ohio in 1808. In 1814 it occurred in New England, and persisted there until 1816. From this date to the close of the period isolated outbreaks occurred in one or two States.

2. (1837 to 1850).—Extensive military epidemics occurred in France during this period. In 1837, epidemic meningitis occurred in Bayonne and the valley of the Adour in the south-west and also in Narbonne and Foix in the south-east. The disease was mostly confined to troops, and appeared to be carried by them to other districts. From 1839 to 1842 other outbreaks, mainly confined to the various garrisons, occurred in the north of France. Further outbreaks occurred in the north-east and south-east, and also in Orleans and Paris, from 1846 to 1850, again largely among the troops. During the same period infected troops carried the disease to Algiers. Considerable epidemics occurred in the south of Italy—1840 to 1850—and in Denmark and Iceland—1845 to 1848.

In Dublin and Belfast a few cases occurred in 1846, and also in Liverpool in the same year.

Extensive epidemics again occurred in the United States during the second period. The disease largely prevailed in the Southern States and remained epidemic during the whole period.

3. (1854 to 1876).—In 1854 the disease commenced to appear in Gothenburg in Sweden, and in the following year spread northwards through the country. It continued to be epidemic until 1855. Most of the cases occurred during the winter and spring months, and proved to be of a very fatal type. In 1863 severe epidemics occurred in the eastern countries of North Germany; in the following year South Germany was attacked, and did not become free from the disease until 1886. An outbreak was recorded in the Crimea in 1867 to 1868.

Scattered cases occurred in England during 1867 and 1868, and there was an outbreak in Dublin, which affected both the civil and military populations.

Small military epidemics again occurred in the French garrisons at Bordeaux during the winter of 1867 and 1868, and also at Strassburg in the spring of 1868. The occurrence of the disease is recorded in Southern Italy, especially in Naples, from 1873 to 1876.

In the United States, epidemic meningitis was prevalent during almost the whole of this period. During the War of Secession, 1861 to 1863, the disease occurred amongst the troops and spread to the civilian population, both white men and negroes being affected. Philadelphia was the scene of a severe epidemic during the winter of 1863 and at the same time the disease appeared in Indiana, Iowa, Newport, etc. In the following year it spread to Illinois and New Jersey, and during each of the remaining years of this period it appeared more or less extensively in various and widely separated States.

4. (1876 to 1884).—During this period the United States was apparently free from the disease.

In Europe only small and scattered epidemics occurred.

In the United Kingdom the disease appeared in Birmingham, 1876; near Glasgow, 1884; and in Dublin, 1884 to 1886.

We have now considered the history of the chief appearances of cerebro-spinal fever in epidemic form which occurred in Europe and America during the period covered by Hirsch.

We must now consider some of the more recent appearances of the disease.

In his *Handbook of Historical and Geographical Pathology* Hirsch states that cerebro-spinal fever is confined to the north temperate zone, and only extends as far south as 30° latitude. This statement is, in the light of more recent knowledge, not strictly accurate, as we have records of epidemics which have occurred in the tropics and in the Southern Hemisphere.

The records available with regard to some of these are extremely scanty, but are still of some interest.

United Kingdom—England.—We have already mentioned the small epidemic described by Hirsch during 1865. In 1885 and 1886 several cases occurred amongst troops at Devonport and also at Chester. During the period 1887 to 1893, 10 cases were admitted to St. Bartholomew's Hospital, and were described by Dr. Omerod in the *Lancet* of March 1895. In 1891 an epidemic,

of which there was considerable doubt as to the real nature, occurred in Northampton. Some 300 children were attacked, and the symptoms were ascribed to "tonsillitis," "catarrh," or "pneumonia," but in a considerable number of these cases head-retraction, with stiffness and pains in the neck, occurred. It is quite possible that these were unrecognised cases of cerebro-spinal fever.

Other small epidemics, presenting more or less the symptoms of meningitis, occurred in Suffolk, 1894—66 cases, mostly children; Lancashire, 1895; and Lincoln, 1897. In the last outbreak the disease was described as "influenza, with cerebro-spinal meningitis," or "influenza with purpura." A few cases were described as occurring on warships at Devonport in 1902.

In 1905, 30 cases of meningitis were reported from Irthlingborough, Northants. The bacteriology of these was investigated by Mervyn Gordon, and the meningococcus was isolated from the cerebro-spinal fluid and also from the nasal secretion. During the later stages of this epidemic many influenza-like cases occurred, and these may perhaps also be attributed to meningococcal infection.

In 1912, cerebro-spinal fever became compulsorily notifiable, and 272 cases were so notified. In 1914, 315 cases were notified. These cases were mostly scattered over various districts, and there were no regular epidemics.

During the last two months of 1914 cases began to appear amongst the troops in training. The first cases occurred amongst the Canadian Expeditionary Force in training on Salisbury Plain. One or two cases had occurred during their earlier training in Canada, and while the Canadians did not introduce the disease into this country, they brought with them new and perhaps more virulent strains of meningococci. During the early months of 1915 considerable epidemics occurred at the various military training centres. These practically disappeared during the summer months, to reappear during the following winter, and to diminish again during the following summer.

During 1915, 2565 cases of cerebro-spinal fever were notified. The epidemic was by no means confined to the troops, and a large number of cases occurred amongst the civilian population.

Scotland.—Cerebro-spinal fever appears to have occurred to a considerable extent in Scotland. In 1877 to 1878, 34 cases in Dundee were reported by Dr. T. Maclagan; and in 1884, Dr. Frew described the outbreak at Galston, Ayrshire, mentioned by Hirsch.

From 1883 to 1895, 73 deaths were notified as having occurred from cerebro-spinal fever. A serious epidemic commenced in 1906, and did not altogether subside until 1909. Glasgow was the chief city affected, and in 1907, when the epidemic was at its maximum, 998 cases were reported from this centre. In 1907 the disease spread to Edinburgh and Leith, but did not prevail so extensively.

Cerebro-spinal fever became compulsorily notifiable in Glasgow in 1906, and in Edinburgh in 1907. During the period 1914-15-16 small scattered outbreaks occurred in connection with the various military training centres, but not so extensively as in England.

Ireland.—Ireland appears to have been more extensively visited by cerebro-spinal fever than any other part of the United Kingdom. As we have already seen, Hirsch mentions an epidemic in Dublin and district in 1884, and again amongst the troops engaged in dealing with the Fenian rebellion in 1886. In 1869 an epidemic occurred in Dundalk—23 cases; and in Dublin in 1885—52 deaths; and again in 1886—20 deaths. In 1900, 204 deaths were reported from the whole of Ireland as being due to cerebro-spinal fever. From this year the incidence declined until 1906, when an extensive epidemic occurred in Belfast and the north. This continued until 1909, and was marked by severe exacerbations during the winter months.

During 1907, 623 cases occurred in Belfast, with 495 deaths, giving a mortality of 79·4 per cent. In 1908 there were 127 deaths. This epidemic corresponds with the epidemic occurring in Scotland during the same period, and in connection with its causation the frequent and close communication between Belfast and Glasgow must be remembered, and also the constant traffic with the United States, where cerebro-spinal fever was prevalent at the time.

France.—In addition to those epidemics described by Hirsch, during recent years continual outbreaks have been recorded from the military centres, a considerable number of deaths being annually notified from this cause. Many of these outbreaks extend to the civil population. Since August 1914 a considerable number of cases have been reported from the troops in the field.

Holland.—During recent years a few deaths from cerebro-spinal fever have been notified—13 in all from 1902 to 1914.

Belgium.—During the period 1910 to 1912, 103 cases were recorded, some being from Brussels, the remainder from various other towns.

Denmark.—From 1888 onward a few deaths have been notified each year, and the official reports show that the disease is almost constantly prevalent in Copenhagen, from which centre most of the cases are reported.

Norway.—A few cases were reported each year, until an epidemic occurred in 1912, the chief centre being Christiania. In all, 364 cases, with 198 deaths, were recorded—200 of these, with 135 deaths, occurring in Christiania.

Sweden.—Since the epidemics recorded by Hirsch, the incidence of the disease declined up to the year 1911, when 611 cases were reported.

Germany.—Over large districts—chiefly Eastern Prussia—cerebro-spinal fever is endemic, with frequent small and occasional widespread epidemics. In the epidemic of 1864 and 1865, which occurred in the valley of the Vistula, and which was investigated by Hirsch and Burdon-Sanderson, about 2000 cases, with over 1000 deaths, were recorded. In this epidemic, which occurred during the winter months, most of the cases occurred in children under 15 years of age. In more recent years the disease has prevailed to a very considerable extent in Prussia, some hundreds of cases being reported annually. A very considerable epidemic period prevailed during 1905 to 1907 on the borders of Austria and Poland; 2715 cases occurred in 1905, 1391 in 1906, and 1769 in 1907. The greater number of cases occurred during the spring months, falling in the summer, to increase again during the winter.

Austria.—Records of infectious disease from this country are extremely scanty. Cerebro-spinal fever is apparently endemic in certain districts, especially Galicia. In 1905 to 1907, coincident with the epidemic in Silesia, there was an outbreak in Galicia, 90 per cent. of the cases occurring in children.

Russia.—Very scanty records are available, but cerebro-spinal fever is said not to be uncommon. An outbreak occurred in Poland in 1905, apparently in connection with the similar epidemics in Silesia and Galicia. There is very close communication between these two districts, many of the workers in the coal mines working in one country and living across the border, travelling daily to and fro.

Egypt.—A few cases occur annually in the large towns—Cairo, Alexandria, etc.

British East Africa.—Imported labourers are said to have introduced the disease in 1900, from Mombasa. A few cases were reported in 1906 and 1907, and in 1913 there was an extensive

epidemic of 1128 cases. The disease was of a comparatively mild type, and was largely confined to males, both youths and adults.

Northern Nigeria.—M'Gahay reported a serious epidemic which occurred at Yola, in the Benin River, 1000 miles from the coast, in 1905. It began in February and lasted until April, which is the hottest period of the year. It spread over a large area, being largely confined to trade routes. Three per cent. to 5 per cent. of the population were attacked, and the mortality was about 50 per cent.

South Africa.—In the *Transvaal* considerable epidemics have been reported from time to time during the last twenty years. Natives are attacked to a much greater extent than whites. In *Natal*, in 1890, an epidemic was reported amongst the natives. In *Cape Colony*, during 1883 and 1884, 1890 cases occurred. Small epidemics have since been reported from time to time.

French African Colonies.—During 1904 to 1906 the disease occurred at several places. During the latter year it spread along the caravan routes to Dahomey, and became widely prevalent.

India.—Cerebro-spinal fever has occurred to a small extent in the Indian Army and in jails for many years, with small epidemics in 1901 and 1902. No figures are available as to its prevalence amongst the native population, where infectious disease is extremely common, and where cerebro-spinal fever would probably be overshadowed by cholera and typhus.

China.—A few cases have been reported by European medical officers in the treaty ports, etc., but we have little knowledge of diseases occurring among the native population.

Japan.—A considerable epidemic was reported in 1912.

Philippine Islands.—Since the American occupation several small epidemics have been described.

Fiji Islands.—Imported labour introduced the disease in 1885, since when cases have been reported annually.

Australia.—A considerable number of cases are reported annually, and during 1915 there has been a considerable epidemic amongst the troops at various training centres.

South America.—In Brazil a few cases of cerebro-spinal fever have been reported in recent years, and, in addition, a considerable number of deaths are annually reported as due to "meningitis." Some of these may be cerebro-spinal fever. In Peru an epidemic occurred in 1910 among troops.

The records of epidemic disease occurring in the South American Republics are very scanty and inaccurate, and it is

quite probable that some of the very considerable number of cases of "meningitis" are really cases of cerebro-spinal fever.

Bacteriology.

Historical.—The causative organism of cerebro-spinal fever was first discovered by Weichselbaum during the examination of exudate from the meninges of a few cases of meningitis which occurred in Vienna in 1887. He described the organism as a Gram-negative diplococcus, occurring inside the polymorphonuclear cells. This organism he called the "diplococcus intracellularis meningitidis." As he found the pneumococcus in one or two similar cases at the same time, he was uncertain how much value to attach to his discovery. He even appears to have suggested that his new organism might be only a variety of the pneumococcus.

In 1895, Jaeger isolated an organism which he considered to be the diplococcus intracellularis, but which was Gram-variable and formed chains in culture. The question as to which of these organisms was the cause of epidemic meningitis raised considerable discussion. In 1898, Councilman, Mallory, and Wright found the diplococcus of Weichselbaum to be the sole organism present in the cerebro-spinal fluid in an epidemic of meningitis in Boston, U.S.A. Since that date numerous observers in all parts of the world have confirmed the association of the diplococcus of Weichselbaum with cases of cerebro-spinal fever. Pure cultures of this organism can be obtained from the cerebro-spinal fluid of persons suffering from the disease, and it is the sole organism present in this situation. It can be grown in culture and it breeds true. If cultures of cerebro-spinal fluid containing the organism be injected intrathecally in monkeys, cerebro-spinal meningitis results. Therefore it may be said that the meningococcus conforms to Koch's postulates as to the specificity of an organism.

Morphology.—The meningococcus is a small diplococcus, the adjacent sides of each pair being flattened. In culture the diplococcus form is not always maintained and single cocci may appear. They do not even appear to form chains. As isolated in one or two cases in the present epidemic, large and small forms have been isolated. These apparently become normal in size on subculture and otherwise they answer the tests for the meningococcus.

The meningococcus is an obligatory anaerobe. It grows freely on various media, but on most it requires to be subcultured every forty-eight hours to prevent its dying. This is particularly so in the case of solid media. In broth to which serum has been added it may survive for as long as seven days.

When the meningococcus was first isolated, solidified blood-serum was the medium used. Since this time it has been found to grow freely on serum agar or on agar to which has been added nutrose and a certain percentage of ascitic fluid. This latter was the medium issued from the R.A.M. College until recently. It proved satisfactory in most respects, but it had the serious drawback that cultures died within forty-eight hours, unless subcultures were made. As supplies of nutrose are now limited, leguminous agar is being largely used. Many variations have been tried by different workers, usually consisting in the addition of blood-serum, or ascitic or hydrocele fluid. The meningococcus grows on milk, but does not produce any change in its appearance. It also grows to a small extent on potato.

The optimum temperature for growth of the meningococcus is 36° to 37° C. Above 42° C. growth is arrested, and, as a rule, the minimum temperature at which growth will occur is 25° C. This minimum temperature is important from a differential point of view. If an organism will grow at 23° C., it is probably not the meningococcus, though there are possibly exceptions to this rule.

The appearance of the colonies on solid media after twenty-four hours' growth at 37° C. is fairly characteristic. They appear as round or slightly oval discs, with a moist, greyish appearance. On examination by transmitted light they are seen to be translucent, and the centre of the colony appears to be somewhat granular. In twenty-four hours the colonies will be found to have attained a size of 2 to 3 mm. Weichselbaum states that the size of the colony depends on the amount of moisture present in the medium. The colonies are not adherent to the medium, and can be removed entire by a platinum needle. A colony of the meningococcus forms a perfect emulsion with distilled water.

Many of the diplococci found in the nasopharynx are chromogenic, the cultures developing a yellow colour. The meningococcus possesses this power to a very slight degree, and colonies are greyish-white or extremely faintly yellow. The meningococcus stains freely with all basic aniline dyes. When stained by Gram's method it does not retain the stain, *i.e.* it is Gram-negative. This characteristic of the organism is very important, and serves to distinguish it from the pneumococcus. In old colonies, and especially in those which have been exposed to the sunlight, a few Gram-positive cocci may be found. These regain their normal staining on subculture. A few cocci from each colony may take the stain only faintly, while others take the stain well.

The former frequently show darkly staining granules in their substance.

Fermentation of "Sugars."—Fermentation taking place in media containing a proportion of various sugars has long been used to differentiate similar species of bacteria. Von Lingelshein was the first to employ this method in differentiating the meningococcus from other Gram-negative diplococci, with which it is often associated. He demonstrated the fact that, of the sugars commonly used for this purpose, the meningococcus fermented maltose and glucose with the production of acid, and not lactose, galactose, or saccharose. Later investigators into this question stated that galactose and sometimes levulose were fermented. Elser and Buntoon pointed out that galactose is exceedingly sensitive to heat, undergoing partial decomposition, and suggested that these discordant observations might be due to this fact. Repeated observations by many observers during the past two years have proved this to be the case, that the meningococcus ferments glucose and maltose, and that acid production in galactose-containing media is due to impurities in the sugar used. In media containing mannose an initial acidity is produced, but fades in a day or two. The amount of acid produced is not great and the rate of production is slow. Three or four days' growth should be allowed before a negative result is recorded.

Serum Reactions.—Albrecht and Ghon in 1901 discovered that the blood-serum of guinea-pigs, which had been repeatedly injected with cultures of the meningococcus, contained agglutinins specific for that organism. By means of this serum the identity of diplococci from cases of meningitis with the diplococcus intracellularis could be proved. Since that date it has been found that such serum contains in addition specific precipitins, etc., and that the complement-fixation reaction can also be observed. In carrying out the agglutination test with the meningococcus it has been found that the macroscopic method is the most satisfactory, and this is generally used.

In 1909, during an epidemic in Paris, Dopter isolated a diplococcus from a case identical with cerebro-spinal fever, which presented the microscopical and cultural characteristics of the meningococcus, but which was not agglutinated by his specific anti-serum. This organism he described as the para-meningococcus, and he was able to demonstrate that it produced specific agglutinins, precipitins, etc., of its own. He was also able to prepare, and use successfully, a specific anti-serum. Since this observation many

other workers, using not only the agglutination but also the absorption capacity and complement-fixation reaction, have demonstrated the existence of several types of the meningococcus and also of the para-meningococcus. Many of these observations are proceeding at the present time, but as yet no conclusive findings have been reached, each observer describing varying numbers of types.

The most extensive observations on this point are those of Lieutenant-Colonel Mervyn Gordon of the R.A.M. College, who has been able to classify the strains from the present epidemic into four types. From each of these types he has been able to prepare immune sera containing agglutinins specific for that type. By using these sera it is possible to determine to which type the meningococcus from any particular case belongs. As the virulence of infection appears to vary to a certain extent with the different types, by this means we are able to obtain indications for prognosis and treatment. The existence of these different types explains the failure of certain cases to respond to anti-serum treatment. The anti-serum at our disposal for therapeutic purposes is of the nature of a polyvalent serum. It is prepared from meningococci isolated from many cases, but those cases which may be described as serum-fast are caused by a variety of the meningococcus to which our anti-serum does not contain specific antibodies.

It has been suggested that, in the first instance, this polyvalent serum should be used in the treatment of a case, that the particular type of meningococcus isolated from the case should be determined, and that subsequent treatment be carried out with an anti-serum specific for that type. This appears to be the counsel of perfection, but until the number of the various types is conclusively proved is hardly practicable. The anti-serum which we are using at present is prepared from strains representing the four types described by Gordon, and in some hands is giving great satisfaction.

Resisting Powers of the Meningococcus.—A great deal of recent work has been done with the idea of elucidating this point. It is one of great practical importance in investigations as to the presence of the meningococcus in the throats of apparently healthy persons during the course of an epidemic. In many instances the material upon which these investigations are conducted must be conveyed some distance to the laboratory, and in this case the powers of resistance of the meningococcus to drying, cold, light, etc., may determine its ability to grow in culture.

Effect of Desiccation and Light.—Exposure of a culture of the meningococcus on dry filter paper to the temperature and light of an ordinary room causes death of the organism in a very short time—within a few hours. Cultures exposed to bright sunlight on solid media died in from five to twelve hours, depending on the season of the year. Death of culture on solid media occurs in forty-eight hours, unless care is taken to prevent drying.

Heat.—The temperature limits of growth of the meningococcus appear to be a minimum of 23° C. and a maximum of 42° C. Failure to grow at 23° C. has been considered to be an important point in the differentiation of the meningococcus from other Gram-negative diplococci, many of which will not grow at this temperature. Recent observations on this point throw considerable doubt on the constancy of this feature, though it is still considered to be a useful test by most workers. Experiments with moist heat show that the meningococcus can resist a temperature of 50° C. for one hour, 60° C. for ten minutes, and 80° C. for two minutes. Higher temperatures are instantly fatal.

Resistance to Antiseptics.—Flugge has conducted a great number of experiments on this point. He finds that 3 per cent. hydrogen peroxide, 11 per cent. silver nitrate, 1 per cent. carbolic acid, 1 per cent. lysol kill in one minute; 2 per cent. protargol, 1 per cent. hydrogen peroxide, 70 per cent. alcohol kill in two minutes. Weaker solutions of these proved fatal in a varying longer period. Weichselbaum found that 1:22,000 formaldehyde rapidly proved fatal. The importance of this observation will be referred to later.

Gram-negative Diplococci Associated with the Meningococcus in the Nasopharynx.—The points of difference between the meningococcus and other Gram-negative diplococci found in the posterior nasopharynx are of the greatest importance in any investigation as to the presence of this organism in this region. The main points to which attention should be directed are the appearance and colour of the colonies on solid media, the fermentation reactions, and perhaps the growth or otherwise at 23° C. In some cases of difficulty the distinction can only be made by carrying out the agglutination test with anti-meningococcal serum. Any organism not agglutinated by such a serum is not considered to be the meningococcus. I give a list of the commonest organisms liable to be confounded with the meningococcus and their points of difference. This list has been compiled from the observations of various observers during the present epidemic. (1) *Micrococcus Pharyngis Siccus.*—Colonies white; ferments glucose and saccharose.

Grows freely at 23° C. (2) *Micrococcus Flavus* 1.—Colonies yellow; ferments glucose and saccharose, but may require two or three days to do so. Grows freely at 23° C. (3) *Micrococcus Flavus* 2.—Rare. Colonies yellow; ferments glucose and saccharose, but requires three or four days to do so. Grows freely at 23° C. (4) *Micrococcus Flavus* 3.—Rare. Colonies yellow; ferments glucose, but not saccharose. May grow at 23° C. (5) *Micrococcus Catarrhalis.*—Colonies white; does not ferment any sugar. Feeble growth at 23° C. (6) *Diplococcus Mucosus.*—Greyish slimy colonies. Forms capsules.

Epidemiology.

The epidemiology of cerebro-spinal fever has frequently presented features which sharply differentiate it from that of other infectious diseases. So much so is this the case that, until quite recently, many observers denied the contagiousness of the disease. With other infectious diseases the progress of an epidemic could be followed from case to case, and the connection between successive cases could frequently be traced. With cerebro-spinal fever, cases occurred more or less simultaneously and separated by considerable distances, and with no apparent connection between them. The disease did not often follow trade routes, and would often attack simultaneously widely separated parts of the country. Epidemic periods recurred at very varying intervals. Most of these features have been brought out in the discussion of historical and geographical distribution.

More recently, however, it has been shown that apparently healthy individuals may carry the specific organism of the disease in their nasopharynx, and may infect others without themselves suffering from the disease. It is in the occurrence of these "carriers" that we must look for the explanation of these peculiar characteristics. We must, therefore, first discuss the epidemiological features, and then see how far they can be explained in the light of recent knowledge.

Geographical Distribution.—We have seen that the disease is of world-wide distribution, and that few countries have escaped its visitation. Hirsch describes its appearance as far north as Iceland, and Sophian mentions an epidemic which occurred as far north as Alaska. We have seen that epidemics have occurred in the tropics, Northern Nigeria, and in the Southern Hemisphere, Australia, South Africa, and South America. Europe and North America, within the limits of the north temperate zone, appear

to be most extensively and frequently attacked, but it must be remembered that very large epidemics might prevail amongst the less advanced nationalities in Asia, Africa, and South America, and little record of them be left.

The Influence of Weather Conditions.—It has been suggested that climatic irregularities predispose to epidemic periods of cerebro-spinal fever, by lowering the local resistance of the naso-pharyngeal mucous membrane to infection. We know that sudden climatic changes increase the frequency of catarrhal conditions of the upper respiratory tract, and it is reasonable to suppose that resistance to the meningococcus is also lowered. This view is strongly held by Sophian, Dopter, and others, and Sophian supports his opinion by his experience in the Texas epidemic of 1912. The summer previous to the epidemic was extremely dry and the winter was unusually rigorous, and accompanied by many sudden climatic changes; this occasioned a great deal of nasopharyngeal catarrh.

In the city of Dallas, Texas, the epidemic commenced in November; 11 deaths occurred during this month; 80 cases occurred in December, 185 in January, and 250 during the following three months. This experience is supported by the epidemic of 1914 in this country. The autumn was unusually hot and dry, and then the winter extremely wet and cold. The clothing and housing of the troops amongst whom the epidemic occurred was unsatisfactory, and many of the men were unaccustomed to an open-air life. The epidemic commenced in December, reached its height in the following spring, and then declined.

The incidence cf other diseases in which the infecting organism presumably enters by the respiratory tract was similar. It is therefore probable that the climatic factor acts by lowering the resistance of the upper respiratory tract to infection by the meningococcus, as well as to other organisms. We shall see later the influence of this in the production of an epidemic of cerebro-spinal fever.

Season.—Practically all the described epidemics of cerebro-spinal fever have occurred during the winter and spring months. In most the point of maximum severity has occurred during the first three months of the year. As the weather becomes warmer and more settled during the summer, the epidemic tends to decrease. During periods of epidemic prevalence the disease does not disappear during the summer, stray cases occurring from

time to time. The influence of season is well illustrated by the present epidemic in this country.

Age Incidence.—Cerebro-spinal fever may occur at all ages. It would appear that in epidemics occurring amongst the civil population children up to 10 years of age are most susceptible. This is well seen in the statistics of the New York epidemic of 1906.

15 per cent. of cases occurred in persons under 1 year.					
29	„	„	„	from 1 to 5 years.	
23	„	„	„	„ 6 to 10	„
18	„	„	„	„ 11 to 20	„

Other epidemics show considerable variations. In very few civilian epidemics, however, has the number of adult cases exceeded those in children. In Glasgow, 1907, 72 per cent. of the cases occurred in children under 10 years of age. In the present epidemic most of the cases occurring among the civil population are in young children. Amongst troops most cases occur between 18 and 24 years.

Sex.—In civilian epidemics there is a marked difference in the proportion of males and females attacked.

Influence of Hygienic Conditions.—Epidemics of cerebro-spinal fever appear to commence, as a rule, in districts in which the sanitary conditions are not good. The disease is associated with overcrowding of dwellings, in which, as a consequence, uncleanliness of persons and of the home prevails. Another factor, and apparently one of great importance, inadequate ventilation, with pollution of the atmosphere, goes hand in hand with overcrowding. It was shown in Glasgow that the influence of dirt was not great, households in which relative cleanliness prevailed being attacked at least as frequently as those which were definitely dirty. In the same epidemic the influence of overcrowding was also remarked. In one dwelling in which ten persons lived and in which the total cubic capacity of the house only amounted to 2100 cubic feet, five fatal cases of the disease occurred.

In military epidemics the same features are brought out even more strongly. The standard of cleanliness, both of persons and of quarters, is much superior to that obtaining in the civilian areas in which cerebro-spinal fever prevails to the greatest extent. The influence of overcrowding in barracks has long been recognised. So far back as 1839 to 40, Gaste successfully dealt with an epidemic at Metz by sending part of the troops elsewhere. The same fact has been noted in many military epidemics, and much

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stress is laid on it by many observers in the present outbreak. During the winter of 1914 and early spring of 1915, when the epidemic was most severe, the enormous number of new recruits and the impossibility of building adequate housing necessitated the great overcrowding of existing quarters and billets. The continuous wet weather also compelled the men to remain in their quarters in the evening, in spite of their crowded condition. The influence of bad ventilation in crowded huts was clearly shown by Lieutenant-Colonel Sims Woodhead. In one overcrowded hut several cases of cerebro-spinal fever had occurred. The ventilation was improved by removing one board from under the eaves, and no more cases were noted.

A peculiar feature of this disease is the rarity of multiple cases coming from one house or barrack-room. This has been repeatedly shown in connection with civil epidemics, and in my own series of cases there occurred, so far as I know, only one instance of more than one case from one quarter within a short period of time.

Meningococcal Carriers.—In 1901 Albrecht and Ghon were able to demonstrate the presence of the meningococcus in the nasal secretion of apparently healthy persons living in the neighbourhood of cases of cerebro-spinal fever. Since this date this observation has been repeated with such frequency that it is now accepted as a constant feature of epidemics of this disease. It is now recognised that the meningococcus is most frequently present in the posterior nasopharynx of such persons. These persons are known as "meningococcal carriers." Their number varies according to different observers and at different periods of the year—from 3 per cent. to 20 per cent. or more of the persons living in the neighbourhood of each case.

They may be divided into two classes—(1) transient carriers; and (2) prolonged carriers.

Transient carriers are those in which the meningococcus may be found for a few days or so. These constitute the great bulk of carriers. Prolonged carriers may retain the organism for as long as six months, or even longer in some cases.

Carriers are not commonly attacked by cerebro-spinal fever, though this is by no means unknown, but it has been repeatedly proved that they may infect other persons with whom they may come in close contact, and that these either become carriers or may suffer from cerebro-spinal fever. We shall see later that the meningococcus is constantly present in the nasopharynx of cases of cerebro-spinal fever during the first day or two of their illness,

and it is more than probable that all cases of the disease are carriers for a longer or shorter period previous to the attack. A small number remain carriers for a considerable period after recovery. A considerable number of observations have been made on the throats of healthy persons who have not been in contact with cases of cerebro-spinal fever, in order to see if the meningococcus is a common inhabitant of the healthy nasopharynx. In a few of these the organism has been found in 1 per cent. or 2 per cent. of those examined, but more frequently the findings have been negative. Flexner has collected a number of tables to illustrate this point, showing the percentage of carriers in various types of population and in epidemic and non-epidemic periods. In populations free from cerebro-spinal fever the number of carriers was extremely small, frequently nil; where there are 1 per cent. or 2 per cent. sporadic cases annually, 2 per cent. or 3 per cent. of the population were carriers, and during epidemic periods up to 20 per cent. and even more amongst persons who had been in contact with cases. The number of carriers is greatest during the height of an epidemic, and falls towards the close.

Investigations during the present epidemic illustrate the same point. Among 1000 non-contacts in a district where there had been no cerebro-spinal fever no carriers were found. Of 480 out-patients of St. Bartholomew's Hospital during an epidemic period, 10 per cent. to 12 per cent. were found to be carriers. During a similar period, 138 persons were examined in Lambeth Poorhouse, and 13·7 per cent. of these were found to harbour the meningococcus.

The meningococcus is most probably transferred from person to person by means of the "droplets" of Flugge, which are projected into the atmosphere from the upper respiratory tract during speaking, sneezing, coughing, etc. The low powers of resistance to drying, etc., possessed by the organism render transmission of fomites, etc., extremely improbable. In a recent paper it is pointed out that in over-crowded barrack-rooms during the night the proportion of water vapour in the atmosphere becomes very high, and the temperature rises to well over 23° C. Under these conditions the "droplets" remain suspended in the atmosphere for up to four hours, and the meningococcus is able to maintain its vitality under these conditions for fully this period. The area of infectivity surrounding each carrier is, under these conditions, markedly increased. As we have seen, these points are borne out by observations during the present epidemic.

The influence of barrack-life on the prevalence of the carrier condition is seen in some figures relating to the French troops in the field. We have seen that sporadic cases are continually occurring in French garrison towns, and the proportion of carriers is correspondingly high. In peace time it amounts to 4 per cent. to 5 per cent. of those in contact with cases. Since the outbreak of war this figure has fallen to 1·33 per cent., and it is suggested, with a high degree of probability, that this is due to the open-air life led by troops in the field.

The Influence of Catarrh of the Upper Respiratory Tract on the Prevalence of the Carrier Condition.—We have previously noted the probability that nasopharyngeal catarrh, by lowering the local resistance of the mucous membrane, may predispose to infection by the meningococcus. Nasopharyngeal catarrh acts in another way—by increasing the amount of coughing and sneezing the number of droplets of secretion in the atmosphere is greatly increased, and if the person so affected be a meningococcal carrier, the number of meningococci is also increased.

With a knowledge of these facts we are more able to understand the peculiar feature of an epidemic of cerebro-spinal fever. The epidemic is, in reality, one of meningococcal carriers, not of cases of the disease, the actual cases being merely visible evidence of the prevalence of the carrier condition. As carriers may beget carriers "even to the third and fourth generation" without the occurrence of a case of cerebro-spinal fever, we can understand the mode of progression of the disease, and the reason for its erratic appearances. The existence of prolonged carriers also explains how the disease may travel from one country to another, and it is probable that these account for the occurrence of sporadic cases, and which preserve the focus of infection from one epidemic period to the next. The small percentage of carriers who develop the disease only shows the degree of local resistance of the mucous membrane of the nasopharynx to infection by the meningococcus, for, as we shall see later, no community has yet developed any general immunity to this organism.

Morbid Anatomy.

The most striking morbid changes in cerebro-spinal fever are seen in the central nervous system and its covering membranes. These changes vary in accordance with the clinical type to which the case belongs, and will be described under four headings—

(1) Fulminating type. (2) Acute type. (3) Suppurative type. (4) Chronic type.

Changes in the Central Nervous System and Meninges.—The changes are those of any other acute suppurative meningitis, associated with a certain degree of encephalitis. The degree of meningitis varies with the type of case and with the duration of the illness.

1. *Fulminating Type.*—Cases belonging to this type run a short acute course, and almost always terminate fatally within forty-eight hours. They may be divided into two classes in accordance with the post-mortem findings, and, as we shall see later, it is possible, clinically, to determine to which class a case belongs.

(*A*) In this class of case the pia-arachnoid is merely congested. The amount of cerebro-spinal fluid found in the lateral ventricles is frequently not increased, and is only very slightly turbid. There may be a certain degree of milkiness along the lines of some of the blood-vessels. These are the only macroscopic changes to be found in the central nervous system.

The characteristic lesions are to be found in other organs, and are invariably present. These consist of a purpuric rash and a hæmorrhagic state of the adrenal glands. The rash is hæmorrhagic and varies in size from petechial spots to large areas several inches square. It is generalised all over the body. The adrenal glands are found to be dull red in colour, enlarged, and friable. They may weigh as much as 24 to 28 grms. Microscopically, the medullary substance is largely replaced by effused blood, and very few chromaffin cells are seen. The various layers of the cortical layer show distended capillaries and red blood corpuscles effused between the cells. The cortical cells are distorted by pressure, and many have lost their normal outline. The refractile granules are much diminished in number. Petechial hæmorrhages into the pericardium and on the serous surfaces of the intestines may frequently be noted.

(*B*) The rash and condition of the adrenal glands is similar to that described above, but the changes seen in the central nervous system and its covering membranes are similar to those occurring in the ordinary acute type.

2. *Acute Type.*—It is in the fairly acute type of cerebro-spinal fever of a few days' duration that we see the characteristic appearances of acute suppurative meningitis. On removing the skull cap the dura is seen to be tense, but is otherwise normal. On

opening this membrane a certain amount of turbid fluid escapes and the vessels of the pia-arachnoid are seen to be intensely injected. The cerebral gyri are flattened, indicating the increase of fluid in the lateral ventricles. When the brain has been removed, there will be found a collection of varying extent of greenish-yellow pus of a thick creamy consistency. It can be demonstrated that this pus occupies the subarachnoid space on the region of the cisternæ at the base of the brain. Thus it extends forward to the optic chiasma, covers the inferior surface of the pons and medulla, and fills the cisterna magna. It frequently extends over the posterior and superior surfaces of the cerebellum, and may also be found over the upper part of the frontal and anterior half of the parietal lobes of the cerebrum. This distribution may be due, at least in part, to the dilatation of the subarachnoid space at the base of the brain.

When the *spinal* dura is exposed, it will be frequently noticed that the surrounding fatty tissue is extensively infiltrated with pus. On opening the dura the pia-arachnoid is seen to be markedly congested, the veins being full and tortuous. The posterior aspect of the cord is covered to a greater or less extent by thick yellowish exudate. The extent of this varies, but the amount is always greater in the lumbar region, next in the cervical region, and the dorsal region is comparatively free. On the anterior aspect of the cord the blood-vessels will be found to be considerably congested, but there is little or no pus. This is due to the presence of the ligamentum denticulatum, which divides the subarachnoid space into anterior and posterior compartments. This separation is not complete, and if the exudate is very extensive it may extend into the anterior as well as the posterior compartment.

The time taken for the exudate to form varies. I have seen extensive formation of pus, covering almost the entire surface of the brain and cord, in a case of apparently only twenty-four hours' duration. For the first few days the changes in the ventricular system are chiefly confined to the choroid plexus. This is extremely congested and may show hæmorrhagic foci. In a few cases in which there is acute internal hydrocephalus, and which may prove fatal within forty-eight hours, there is some dilatation of the ventricles, but it is not very marked. In cases where the duration of the illness has been from eight to ten days there is considerable dilatation of the ventricles, and they will be noted to contain thick pus or turbid fluid. The ependyma of the

ventricles has lost its lustre and the choroid plexus is of a dull purplish colour. On sectioning the brain tissue, it is found to be œdematous and there may be present small hæmorrhages and areas of softening. Occasionally large hæmorrhagic foci occur, and these account for at least some of the paralysis noted during life.

On *microscopical examination* of the meninges the pia-arachnoid will be found to be in a condition of purulent infiltration. The leucocytes present are almost entirely of the polymorphonuclear variety, some containing intracellular meningococci. A considerable number of organisms can also be seen to be free in the perivascular lymph spaces. At first the leucocytes are seen chiefly in the neighbourhood of the capillaries, but soon the infiltration becomes general. In the exudate in the subarachnoid space polymorphonuclear leucocytes will also be found to predominate, but there are also present lymphocytes and large endothelial cells. Intra- and extra-cellular meningococci will also be seen in varying numbers. The infiltration of the meninges extends to the superficial layers of the nervous tissue, and a few polymorphonuclear cells can be demonstrated amongst the nerve cells of the brain and cord. Netter describes a condition of vacuolation of the multipolar nerve cells, especially of the anterior horn or the spinal cord, but the existence of this condition is doubtful. Degeneration of the myelin sheaths of the nerve fibres may occur in the superficial layers of the cord. Cholin, one of the products of degeneration of myelin, can be demonstrated in the cerebro-spinal fluid.

Heart and Pericardium.—The heart muscle may show a condition of cloudy swelling. Several observers have described the presence of acute endocarditis, and have even demonstrated the presence of meningococci in vegetations on the heart valves. Petechial hæmorrhages into the pericardium at the base of the heart are sometimes noted in the more acute cases. Purulent pericarditis is occasionally seen, and meningococci can be seen in the cells of the effusion. These cells are largely polymorphonuclear leucocytes.

Bronchi and Lungs.—Evidence of acute bronchitis may be present. Areas of pneumonic consolidation are frequently to be found, chiefly in those patients who have been unconscious for some days. Apparently they may be either pneumococcal or meningococcal in origin. Hypostatic congestion may be marked in similar cases. Pleurisy, with or without effusion, is occasionally noted.

Kidneys.—Congestion and cloudy swelling are fairly frequently seen, but many cases, in which there has been marked albuminuria and even hæmaturia, show remarkably little change in the kidneys.

Adrenal Glands.—These may be congested, but do not present the hæmorrhagic condition seen in the fulminant type.

Spleen.—The spleen is most often slightly enlarged, but shows no characteristic change.

Liver.—Considerable areas of fatty degeneration are very frequently noted, more especially in the fairly acute case of several days' standing.

Skin.—In a few cases petechial hæmorrhagic spots occur, but not nearly to the same extent as in the fulminant type.

Joints.—Evidence of joint affection is seldom seen post-mortem. A purulent synovitis may occur.

General Nutrition.—Extremely rapid wasting occurs in many cases, and in these the subcutaneous and internal fat is almost entirely absent.

3. *Suppurative Type.*—To this type belong those cases in which the cerebro-spinal fluid daily becomes more and more turbid, until finally it will not flow through a lumbar puncture needle. The morbid changes are similar to those found in the acute type, only much exaggerated. The purulent exudate occupies similar situations in the cranial subarachnoid space, but is more abundant. In the spinal region the space is obliterated by the accumulation of thick cheesy pus, which completely covers the cord. In a few such cases the exudate is confined to the posterior compartment of the spinal subarachnoid space, the anterior surface of the cord remaining clear. The ventricular system contains excess of fluid with, as a rule, thick pus in both anterior and posterior horns of the lateral ventricles. The changes found in other organs are similar to those of the previous type.

4. *Chronic Type.*—Cases belonging to either the acute or the suppurative type may become chronic. There is in this type little evidence of any infective process. The morbid changes are due to imperfect absorption of the exudate and to the interference of the cerebro-spinal circulation, of which this is the result. On opening the cranial dura mater of such a case a considerable amount of clear fluid escapes. The cerebrum is pale and anæmic instead of congested, and the gyri are markedly flattened. Extensive thickening and matting together of the meninges at the base of the brain will be noted, and some thickening remains in the regions where we have seen the exudate to be most abundant during the acute stage.

Unabsorbed remnants of exudate may still remain in the basal cisternæ, but frequently these have been completely absorbed. In the spinal region we find similar conditions—the exudate has been absorbed or organised. Extensive adhesions between the pia and arachnoid partially obliterate the subarachnoid space. This division may completely divide the space into an upper and lower compartment. If this division is complete, the upper part of the space may be distended with fluid and the lower part empty. A ring of adhesions of this nature may so constrict the cord as to cause complete destruction of nerve tissue and paralysis below the level of the lesion.

The nerve roots as they leave the cord are more or less embedded in a greyish gelatinous material.

The ventricular system of the brain is always dilated, *i.e.* there is always a marked internal hydrocephalus. Frequently all the ventricles share in the distension, and in this case dense adhesions will be found in the region of the foramen of Magendie and foramina of Lushka. In other cases the third ventricle and the foramen of Munro are filled with the gelatinous material, and in this instance, while the lateral ventricles are extremely distended, the fourth is not affected to the same extent.

In contrast with the anæmic condition of the cerebral blood-vessels there will be found an area of congestion in the fourth ventricle in the region of the calamus scriptorius. The importance of this lies in the fact that this is the situation occupied by the respiratory centre.

The brain tissue is much softer than normal, that in the neighbourhood of the ventricles appearing to be partially disorganised by the continual pressure. Considerable areas of softening may be found in the cerebral hemisphere.

General Condition.—Wasting is extreme, and in a well-marked case no adipose tissue is to be found. The internal organs, as a rule, show little change, with the exception of fatty degeneration of the liver. The above description is taken from a case of long standing, probably six or eight weeks or even longer. The chronic is a development of an acute type, and as death may occur at any point in the course of the disease, many cases intermediate between the two types will be seen. Thus the purulent exudate may not be completely removed, and considerable accumulations may remain in the horns of the lateral ventricles, the basal cisternæ, and elsewhere.

(*To be continued.*)

TWO CHILD-WELFARE SCHEMES.

By GRACE H. GIFFEN DUNDAS, F.R.C.S.I., D.P.H.(Camb.).

Having completed eight months as medical officer to the child-welfare scheme in Leith, and having previously to that been medical officer to the child-welfare scheme in Ramsgate, it is of interest to compare the two.

Child-welfare schemes are divided into two varieties, viz. those in which the educative and advisory factor predominates, and those in which the curative factor predominates. Both varieties of scheme can be efficiently worked to the decrease of the infantile mortality figure. A drop in the figure and the higher standard of fitness in school entrants are to be the two proofs in a few years of the value of child-welfare schemes. The ideal scheme includes the two varieties, that is, both educative and curative measures.

A general outline of the two schemes with which I have been associated may first be given. In Ramsgate, educative methods are in predominance; in Leith, curative. In both boroughs the scheme had as its foundation the Notification of Births Act. In both boroughs the standard of one health visitor to every 500 births a year prevails. In both boroughs uniformity of teaching by members of the staff is emphasised, the teaching being the most modern, from such men as Truby King, Eric Pritchard, etc. In both boroughs prenatal work is included in the scheme, as are also nursing mothers, and children under 5 years of age. In both boroughs notified cases of measles and whooping-cough are visited—by the medical officer to the scheme if the case is notified by the mother, and by a health visitor if the case is notified by a doctor. No great hopes are entertained of preventing the spread of measles and whooping-cough by notification and visiting, but great hopes are entertained of preventing sequelæ and deaths.

In *Ramsgate* a voluntary agency took up the care of expectant and nursing mothers, and of children between 1 and 5 years of age, before the local authority lent its aid. The latter confined its attention to infants under a year old. The voluntary agency is of the nature of a Maternity and Mothercraft Association, and pays its expenses by voluntary contributions. Before the war its medical officer was a general practitioner of the town. When he joined the R.A.M.C. the opportunity was taken of co-ordinating the work of the voluntary agency with that of the municipality

The nurse-superintendent (a certified midwife and a qualified nurse) of the voluntary agency was appointed a municipal health visitor, half her salary being paid by the voluntary agency and half by the local authority. Inasmuch as I was acting medical officer of health at the time, I became medical officer to the voluntary agency and a member of its executive committee. A woman member of each of the two municipal committees interested in child welfare (sanitary and education) represented the local authority in the voluntary agency committee. Being thus well co-ordinated with the local authority the voluntary agency was able to claim its 50 per cent. grant from the Local Government Board.

The voluntary agency has two paid members on its staff, the nurse-superintendent and a midwife. The rest of the staff is voluntary. The voluntary workers do no visiting but confine themselves to work inside the building, which is open two afternoons weekly, once for purposes medical, and once for purposes non-medical, or, as the mothers put it, once for "the mothercraft consultation," and once for "the mothercraft club." The consultation is open to expectant and nursing mothers, to infants, and to children under 5. No treatment is given, but advice as to hygiene and feeding. If treatment is required, a mother is told to call in a doctor or to go to the dispensary. The majority of the attendants are non-thriving babies. The other afternoon on which the building is open is attended by about 100 mothers (population of Ramsgate 30,000). I have to confess that only occasionally was one of the submerged tenth present. The mothers bring with them as many children as they like under 5 years of age. The maximum number I knew of as belonging to one mother was five. The children are deposited for the afternoon in two nurseries, one for infants, and one for children between 1 and 5. These nurseries are well staffed by voluntary workers. Having got rid of their babies, the mothers then congregate in the lecture-room, pay their penny, get a cup of tea and a biscuit, and hear the order of the afternoon. Sometimes a short lecture is given by the medical officer, nurse-superintendent, or a voluntary worker. These lectures are of the simplest character on subjects, and given in a manner calculated to interest poor mothers. The subjects discussed were mothers, babies, vermin, backyards, etc. One voluntary worker gave "economics in war time," and told how almost the poorest mother could participate in the war loan. Alternating with or following the

lecture is time spent in the workrooms. The mothers bring their mending, sewing, and knitting. They are taught how to cut out and make children's simple clothes. Voluntary workers take charge of this department.

The *Leith* scheme is wholly municipal. The medical officer gives her whole time to the work. A clinic is held twice weekly for infants and children under 5 years, and once weekly for expectant and nursing mothers. Actual treatment other than surgical is of course undertaken at the clinic. Children too sick to be brought out are visited and treated at their own homes. In short, the work is that of a general practitioner as far as patients eligible for treatment under the scheme are concerned. Drugs are free. Occasionally a feeding-bottle is given free, as, for example, where one advises that a long tube be thrown in the fire. Very needy cases are given dried milk free, either for a baby or a nursing mother. In my estimation (probably anticipatory of a State medical service) this free treatment ought to be open to households where the total income does not exceed £130 a year. In a good many cases I know the income, as it is one of the items to be filled up on the health visitors' baby cards. In no known case has the income reached £2, 10s. a week. I am under the impression that few, if any, cases have come to my clinic who can afford a private doctor. If a mother says that she has had Dr. —— in her house previously, she is always encouraged to call him in again.

The only educative work undertaken as yet in Leith is individual teaching, given to mothers as occasion presents itself. The services of voluntary workers are utilised for the weighing of children in the clinic and for the caring of them during the afternoons in the Convalescent Home. They also visit selected babies with the object of noting any deviation of health from the normal in the case of all children under 5 in the given homes, and sending such children to the clinic. With the present staff of health visitors we aim at bi-monthly visits to all babies until they are a year old, and bi-annual visits to children between 1 and 5 years old.

The medical officer is the chief inspector of midwives, a difficult post, inasmuch as several of the midwives have practised in the town for more than twenty years, and still perpetrate such treatment as squirting milk from the mother's breast into the eyes of a baby with ophthalmia neonatorum.

In the end of July a municipal Convalescent Home was opened

for children. At the moment there are only twelve cots used, though there is room for forty or fifty. The principle underlying the selection of cases for admission is the probability of making and keeping a child fit. Thus one would choose healthy children convalescing from an acute illness, which ought to leave no sequelæ, rather than tuberculous children convalescing from the same illness. One would admit a tuberculous contact rather than a case of tuberculosis, and a child in the early stages of rickets rather than one whose bony deformities are already well marked. Children suffering from malnutrition due to bad feeding and neglect are excellent cases. In short, the population will benefit most if children whom it is possible to make and then to keep fit are admitted. Minor treatment is undertaken in the Home, *e.g.* running ears, and massage for deformities in rickets.

One does not yet know to what further uses the Home will be put, but the following suggest themselves to bring the Leith scheme up to its full efficiency. At the moment, the amount of money the local authority has decided to spend on the Home during its first year does not admit of anything but the care of twelve children at a time:—

1. A municipal crèche for the use of mothers who go out to work.

2. A play centre for the use of children whose mothers do not go out to work.

3. Simple educative classes for mothers on such subjects as the economic spending of the weekly money; practical demonstrations on the cooking of cheap dishes; practical demonstrations on the making of children's clothes, etc.

4. The training of children's attendants by the matron. Girls of from 14 to 18 could receive an excellent training as children's nurses, receiving board, uniform, and a small wage.

5. Classes for elementary school girls of 12 and 13 (leavers). I made an attempt to institute such a class in Ramsgate, and ascertained that though the Board of Education would not give a special grant for the class, they would recognise the class as a substitute for an ordinary school attendance. My local authority thought they could not manage the class without a grant. The class would deal with personal, domestic, and infant hygiene.

6. A similar evening class for young women.

No one interested in the urgent question of natural increment of population any longer suggests that too much is being done for the lower classes. A few years ago the cry was that nothing was

done for the middle classes, and everything for the lower classes. The middle classes seem to have put that right for themselves by refusing to have children at a normal rate, which leaves the country dependent on its lower classes for recruits to the population. Fortunately they have not yet learned, as the French have, and as our own upper and middle classes have, to limit the size of their families by preventing conception.

It is not to be supposed that it is the matter of any English borough as against any Scottish burgh when I give the following items of contrast between Ramsgate and Leith. They are almost parallels as far as dates are concerned, inasmuch as I put in my last day's work in Ramsgate on 28th February 1917, and my first day's work in Leith on 1st March 1917:—

1. *Breast-Feeding.*—In Ramsgate the number of babies who are breast-fed up to the sixth month or longer is only about 60 per cent. In Leith the difficulty is to get a mother to wean a child. It is no uncommon sight to see a child of walking age run to its mother for a drink.
2. *Rickets.*—This disease is unknown in Ramsgate and very common in Leith. Even breast-fed babies have it. Two predisposing factors may be at work. Ramsgate water is very hard, and tenement houses are unknown there. You will hear the hard-worked mother of a large family living in the top flat of a tenement house in Leith say the baby is never out.
3. *Poverty, Diet, and Vermin.*—These are all more marked in Ramsgate than in Leith. In this fact I refer to the period of the war. In pre-war days Ramsgate was dependent upon its fishing industry and holiday visitors. Wages are lower in Ramsgate. A charwoman, for example, gets 4d. an hour. By the same token doctors' fees are lower.
4. One staple article of diet in Leith is unknown in Ramsgate, viz. oatmeal porridge and oatmeal cakes. On the other hand, fruit is plentiful and cheap.
5. It is no uncommon thing to find a mother who cannot read in Ramsgate. Leaflets are of no use in these conditions.

The Leith scheme, though it has by no means yet reached its full efficiency, bids fair to be a satisfactory scheme. Month by month fresh activities are entered upon. Vaccination is done free; spectacles are provided for children requiring them; midwives are supplied with leaflets of a very simple character to be given to

expectant mothers when the latter enter their names with the midwives. At the present moment negotiations are in progress for operative treatment for tonsils, adenoids, and teeth, which ought to relieve congestion so far as the education authority is concerned. Free dinners and dinners at a small price are offered to needy expectant and nursing mothers. Dried milk is also sold at half the cost price, either for a baby not on the breast or for a nursing or expectant mother.

There is an almost insurmountable difficulty in fixing a standard of neediness. Cases which show good results are considered to have been satisfactorily selected, *e.g.* non-thriving babies who are not on the breast and who begin to gain weight when put on dried milk, or mothers who complain that their milk is leaving them and whose output is increased when they drink a cupful of dried milk night and morning. Another great difficulty is the making sure that the mother for whom a dinner is intended gets it herself. Naturally she does not like to leave her own house at the dinner hour to take a free dinner where the local authority provides it, and if she sends for a free soup dinner to be carried to her own home, it is a delicate matter to send a health visitor to see that the mother takes the soup herself while the rest of the family takes "a drop of tea and a piece." The solution to the last difficulty is, of course, the provision of communal dinners for whole families, apart from the child-welfare scheme. In Ramsgate there is a soup kitchen to which streams of children and adults with 2d. in one hand and a receptacle (jug, pitcher, ewer) in the other are seen making their way at 12 midday.

THE TRAINING OF THE STUDENT OF MEDICINE:

An Inquiry Conducted under the Auspices of the Edinburgh Pathological Club.

I.—THE AIM OF MEDICAL EDUCATION.*

By Sir JAMES MACKENZIE, M.D., F.R.S., F.R.C.P., LL.D.

It was a pleasure and honour to me to receive your invitation to address you on medical education. This subject has been an object of interest and study to me for many years, and I have formed certain very definite opinions as to the manner in which it should be con-

* Being the Inaugural Address of the 181st Session of the Royal Medical Society, delivered on 9th November 1917 to the Society and the Edinburgh Pathological Club.

ducted. Moreover, the time the Pathological Club has chosen for its investigations is extremely appropriate, for the next few years will see great changes in the relation of medicine to the body politic, while the present time, with its grave effects upon every phase of life, reacts strongly upon medicine, and shows to the inquiring eye many defects which might have been avoided had the teaching of medicine been different.

It is well for a man engaged in any work to have a clear perception of his aim, and from time to time to pause and consider whether he is pursuing his aim by the best means. It is particularly necessary for the teacher of medicine to do so. The great tendency of the human mind is to fall into a groove and pursue its work on lines that give no occasion for mental strain. Mental effort is often exhausting, and as years pass it becomes ever more and more irksome, so that with an everchanging subject, such as medicine, it is well that the methods of teaching should be repeatedly overhauled.

An uneasy sense is beginning to prevail that all is not as it should be in the medical world, and of late years several attempts have been made to place the teaching on a better footing. We have, for instance, the reports of Abram Flexner on the teaching of medicine in America and in Europe. These reports are full of the most interesting and illuminating facts, and they should be carefully studied if we wish to grasp the ideals and methods that prevail in the different countries. We have had, again, the evidence given before the Royal Commission on University Education in London. Here we have the views, in detail, of some of the leading teachers of the world. It might be said that with such recent and abundant testimonies there is no need for any further inquiry, and that your labour and mine will be a work of supererogation.

Long before these inquiries had been made I was studying the subject, and I eagerly read these publications, and found that I had approached the subject from a point of view that neither Flexner nor any of the witnesses before the Commission had taken. These give the views of the doctrinaire and the teacher; my experience was that of the taught—one on whom the experiment had been made.

In all the inquiries of the past there has been this curious limitation of outlook. The effects of teaching upon the general practitioner, so far as it qualifies him for his work, has received little or no consideration. Doctrinaires, like Flexner, have said such a system is bad, and such a system is good, but this is done entirely from a purely theoretic standpoint. Similarly, running through the whole of the evidence of the distinguished teachers the matter is always presented from the teachers' point of view—the effect of their teaching is not inquired into, and it is tacitly assumed that the teaching has been good enough for the general practitioner. It never seems to have occurred

to those who selected the witnesses, nor to the distinguished members of the Commission, that an instructive light might be thrown on the subject by getting the evidence of those who had received the education, and who had tested its practical efficiency. This inability to realise that there was an essential source of information untapped brings out one of the greatest defects in our methods of dealing with medicine. It shows such a profound misconception by those in authority of what clinical medicine really is, that any policy that is based on this restricted evidence is bound, in the long run, not only to retard the progress of medicine, but to set it on such wrong lines that more harm will result than if the matter were left as it is. This is my view of the recommendation of the London Commission and of Flexner, and it is because I strongly hold this view that I am here to-night, and welcome the fact that you also are not satisfied with these reports, but are determined to submit the matter to an independent investigation.

These reports, however, are valuable if for no other reason than that they are warnings of the methods to avoid. To begin, no one seems to have recognised the peculiar nature of the subject with which they were dealing. Medicine has only recently come to be considered as a science; its peculiar nature has not been recognised, and every academic scientist or educationalist believes he is able to indicate the lines on which it should be pursued. It has so many branches, some of them pursued by strictly limited methods, that the methods of one branch are often supposed to be applicable to all others. Thus we have the various branches insisting on their special importance, and so insistent is their attitude that we find a limited section dominating the whole science. Thus the laboratory and hospital worker have practically acquired the power to guide and regulate the teaching and investigation of the whole sphere of medicine, totally unaware that great fields of medicine essential to progress lie outside their spheres. When those with a limited outlook become the guides in any enterprise, error and inefficiency are bound to hamper their efforts. It behoves us to avoid this, and to do so we must have clearly before us what is the goal we desire to reach; and when this is clearly understood, little difficulty will be experienced in realising how best to achieve our object. It is the absence of the conception of a definite object, with the consequent inability to perceive the nature of the defects in teaching, that renders the evidence before the London Commission so ineffective.

In dealing with this matter I approach the subject from a point of view that has not been considered, viz. that of a general practitioner who has sought for the varied phases of disease and has had the defects of medical education forced upon him. In an attempt to supply these defects I was forced to undertake research upon lines that had been very imperfectly understood, and in prosecuting this research I became aware not only of the defects, but of the attitude of the teaching

profession towards medical problems. I have found it most difficult, indeed impossible in many cases, to convince our authorities of these defects, and, in consequence, they have not been able to grasp the reasons for a reform in teaching. As I realise that, before an attempt at reform can take place, it is absolutely necessary that you should realise what are the deficiencies in our knowledge of medicine, I shall to-night limit myself mainly to calling attention to certain fields of knowledge which are necessary to advancement of medical science, and try to show how restricted is our knowledge of this. This point of view is, I recognise, mainly personal, but I would like you, in your investigations, to spend some time in seeing if the condition of medical knowledge is as I describe it. If you can see its condition from the aspect I present, then the path of reform will be made fairly easy.

The Aim of Medical Education.—The aim of the medical profession is to prevent and cure disease, and to relieve suffering. But before we can do either of these things it is necessary to recognise the disease, the manner of its onset, and the course it pursues. The aim of medical education is to enable the practitioner of medicine to detect disease, to recognise its dangers, and to instruct him how to prevent and combat them. This has been the aim in the past, but the methods pursued have shown that the aim was not clearly grasped, as we find that only a limited knowledge has been acquired of the great majority of diseases.

To appreciate how this aim may be attained, let us pass, in brief review, the life-history of disease. Its onset in the body is invariably insidious with little disturbance of the economy and no visible sign of its presence. By and by the patient becomes conscious that all is not well with him; there is a loss of that feeling of well-being which accompanies the healthy state. Disagreeable sensations arise, at first vague, but later they become more definite, and these may become so urgent that he seeks advice. Still no evident sign of disease may be perceived in the most careful examination. By and by the disease, being situated in some organ or tissue, changes the constitution of the part, so that its presence is now recognised by a physical sign. The course hereafter varies—it may end in death or impaired health, or, being of a temporary nature, in recovery. The course of the disease may be a matter of days or many years, but the general characteristics are the same.

We, as doctors, detect disease by the presence of symptoms. Hitherto in medicine the chief progress has been made of the minute study of disease after the patient has died, or after it has produced a physical sign—that is to say, after the tissues have been damaged. So that one might say that the last fifty years of medicine has been the era of physical signs.

Early Stages of Disease.—It is universally accepted that the earlier

a disease is detected the more amenable it is to treatment. It behoves us then to recognise disease in its earliest stages. If you will give careful consideration to the matter you will realise the importance of recognising the early stages of disease, and, moreover, you will discover that, from the patient's point of view, it is vastly more imdortant to observe the early stages of disease than to recognise its peculiarities when it has produced physical signs, or when it is found on the post-mortem table.

Attitude of Teaching to the Early Stages.—What are we doing to discover these early stages? The teaching section of the profession may admit the truth of the proposition that the earlier a disease is discovered the more hopeful it is for treatment, but they have never realised how little they do to provide the necessary knowledge. To appreciate this, look at the attitude of the teaching profession towards the study of disease, bearing in mind always that the patient's interest is our chief aim.

Hitherto research has been restricted chiefly to laboratories, and in a less degree to hospital wards. Consider the stages of disease you find there studied. It is unnecessary to dwell upon the careful study in the post-mortem room, as that is a stage which does not interest the patient. In hospital wards we find the patients with disease so far advanced as to present a physical sign, and you all know what time and care is spent on teaching the physical signs. You know also that little interest is excited in the student unless there is something he can either see, hear, or feel, with the result that the well-trained student leaves the hospital convinced that he has grasped the essence of medicine because of his ability to detect a physical sign and to know the mechanical basis of its production. Moreover, in the more advanced schools, where there are clinical laboratories, it is always to the wards that they are attached. This gives the opportunity of confirming the knowledge of the cause of the physical signs, and stamps the impression on the student of the essential importance of physical signs. We see, therefore, that disease, when it has reached an advanced stage, and after it has killed the patient, has been very thoroughly studied.

But what of the stages that preceded? What of the time, it may be many years, of the gradual progress of disease before the production of a physical sign—the time when the disease was amenable, it may be, to treatment, or more amenable to mitigation than in the later stages?

The patient in the early stages shows no objective sign, but he has a definite sensation which tells him that all is not well. We all know that such patients go to the out-patient department. Here we have the younger members of the hospital staff—men who have been trained in the hospital wards, where the training has made them adepts in the detection of physical signs. What is their attitude? I have visited

many hospitals in this country and abroad, and the procedure is wonderfully alike; wherever I have gone, a patient with no physical sign is put off with a bottle of medicine and told to come again. He may do so for a month or a year, until a physical sign is detected, and then he may be sent to the hospital ward.

Now I know that this description will be contested by many as an untrue or exaggerated description of the way things are managed in some particular schools or hospitals, and I admit that exceptions exist here and there, yet it is sufficiently accurate to be of use in focussing your attention on the defects of medical teaching. I have presented this view to many of my teaching friends and they have resented it, and told me that they had gone through many years of out-patient practice and had observed all that there was to be detected in the cases without physical signs.

The Lack of Knowledge of the Phenomena Produced by the Early Stages of Disease.—My reply is, that they had gone through their work in a state of partial blindness. It will no doubt be granted that subjective sensations are the earlier signs of disease, but the profession has never been trained how to examine a patient when the disease only presented subjective sensations, so that the out-patient physician has not known how to set about the examination. The reason that I make this statement, without fear of contradiction, is, that the sensations of a patient have never been studied with that care and precision which would enable any teacher of the present day fully to appreciate them. There is not a single sensation which man is capable of experiencing that has been thoroughly investigated. Until that is done we shall be incapable of detecting the early stage of disease, and it is because this has not been done that I state that the out-patient department has not yet been fully utilised. Take the most universal of all sensations, that of pain, a sensation which, if understood, would reveal the early stage of disease in large numbers of cases. Yet we are ignorant of the most elementary facts necessary to its understanding. We do not even know the tissues capable of producing pain, and we have but the slightest knowledge of the nature or kind of stimulation that can induce pain. We are to a great extent ignorant of the mechanism by which it is produced, and of the laws governing its radiation we have no knowledge. We know, for instance, how informative the spread of pain is in heart disease or renal colic, because the distribution of the pain is so remarkable; but the distribution is equally informative in many other diseases of which we know little or nothing. It may be said we know as much as is necessary for practical purposes, but thus speaks the man who wilfully shuts his eyes to the light, and the truth is not in him. As one who has laboured much at the subject, I assert that, once we have discovered all the facts concerning pain, a stride forward in our knowledge of clinical medicine will have been made

which will lead to some of the greatest discoveries in medicine. What is true of the neglect of the study of pain is true of every other sensation, such as exhaustion, giddiness, faintness, palpitation, nausea, heartburn, breathlessness.

Does it not strike you as most anomalous that there should have been spent a vast amount of labour in minutely scrutinising the tissues of a man after he has died, or in patiently studying a microbe that has been detected in his body, noting what happens to it in test-tubes and in nutrient fluids, and in guinea-pigs, and yet the signs which show the disease in its entrance into a man's body, which would have warned us of its presence and given us a clue to his treatment, have received relatively little consideration.

The Reason the Early Stages are Unknown.—You will understand, then, that an imperfect conception of what is the aim of medical science misleads the teachers, and not only reacts upon the students, but hampers progress. It is evident that the study of the early stage of disease is of the very first importance, that it is fraught with difficulties, and that the recognition of the nature of the disease is infinitely more difficult at this stage than when a physical sign is present. Yet observe how topsy-turvy is the conception of teaching—the easily discovered stage of disease, and the most hopeless for treatment, is by custom handed over to the experienced physician, while that which is most difficult to diagnose and the most hopeful for treatment is placed in the hands of the least experienced. This, then, is one matter we must clear up before we attempt to alter the methods of teaching.

The Progress of Disease.—There is another aspect of medicine which the teachers in the past have failed to appreciate at its true value, and that is the course a disease runs, particularly those diseases of long standing. It must be apparent to every man who gives thought to the matter that before we can intelligently treat a disease we must know how it will affect the individual suffering from it. Not only is this of importance in order to estimate the future life of the individual, but also to give us the knowledge whether the disease is amenable to treatment. This field of medicine is that which is included under the term "prognosis," and it may surprise many of you when I state that this field, so essential to medical knowledge, has seldom been properly inquired into. We constantly get addresses on the importance of the subject, and in all our text-books there is devoted to every disease a chapter or at least a paragraph on "prognosis." The admiring reader cannot but be impressed by the apparent fulness of knowledge and imagine that the subject has been thoroughly studied. Unfortunately this is not the case, for when we go carefully into any single protracted disease we discover that of accurate knowledge there is indeed very little. To bring the matter home to you we may apply such a test as the following:—Let a general practitioner discover in his patient an abnormal sign, such

as a murmur or an irregularity of the heart. He wishes to know what significance it may have in the patient's future. He turns to any number of text-books, written specially for his edification, and does not find the desired knowledge. This lack of knowledge has been more than ever forced upon me during the last few years, on account of the attitude of many of the profession to recruits and soldiers who have murmurs. The inability to estimate the value of murmurs is, in my experience, almost universal. It is a matter I have laboured at for many years, and I have acquired a limited amount of knowledge, so that I can estimate the value of some murmurs. I am daily seeing people whose lives have been rendered miserable, whose careers have been interfered with, who have been subjected to prolonged and expensive treatment, all because of the inability to estimate the significance of a murmur. While writing this address I was consulted by a young lady who had been told she had an incurable affection of the heart, was forbidden to play games, and prevented being sent to a college, and warned she would never be able to marry, because of the presence of a murmur. There is no use blaming the doctor; the fault lies in the teaching.

Limited Opportunity for Teachers to Study the Progress of Disease.—The source of the fault lies in the fact that it has not yet dawned upon the profession in what manner this important subject should be studied. The experience of teachers is mainly restricted to the laboratory and hospital. Now, to get an insight into the course of disease it must be watched from its onset, during all the vicissitudes of life, till the end. In neither laboratory nor hospital can this be attained, for reasons I need not dwell upon. Our teachers there have not the opportunity of following individual cases to get the requisite knowledge, and I do not blame them for not acquiring a knowledge of which their circumstances have denied them an opportunity. It is necessary that they should frankly recognise their limited opportunity and the great deficiency in their knowledge. I have just been reading a most valuable work upon arteriosclerosis by a great teacher and physician. All his cases quoted and all his experience are limited to the later stage of the disease, and one searches in vain for a hint as to the onset and progress of this condition. It is like reading the last volume of a three-volume novel, the first two volumes being lost. One wonders how the last stage was reached. Again I do not blame the writer for this deficiency, because circumstances denied him the opportunity to see the early stage. But he should have realised his lack of opportunity, and recognised that the disease he dealt with could only be seen in its entirety by one who has had the opportunity of watching it through all its stages, and that individual was the general practitioner. Being a teacher he should have recognised the limited nature of his own experience, and instructed the student that he was the person who would have the opportunity

In addition, he should have taught him what methods he should employ to fill up the great gap in our knowledge. What is true of this particular disease is true of all others.

How the Lack of Knowledge of the Early Stage and Course of Disease Hampers Progress.—This great defect in our knowledge of the course of diseases reacts upon medicine in many directions. There is a belief amongst teachers that they possess this knowledge, while all the time their knowledge is slight and vague. The result of this defect is that other departments of medicine are rendered sterile and ineffective. There are many problems crying out for solution, and all attempts to solve these fail because of this deficiency in knowledge. Indeed, when attempts are made to solve them, there is often no one with the necessary knowledge even to know how to proceed. Take one or two instances. There is not a general practitioner but will be faced time and again with the question whether a woman with some affection of the heart is able to undergo the strain of pregnancy with safety. If you will consider the importance of this question .to the woman, her husband, and her family, and to the doctor on whose decision life or death depends, you must realise the importance of the problem. Yet those to whom we look for guidance have utterly failed to solve this problem, and they do not even know how to set about to solve it. Take another illustration which should appeal to the men of the Edinburgh School of Medicine. There is no tradition of which our school should be prouder than its bringing into practical use chloroform anæsthesia. For many years chloroform was used freely and fearlessly without the slightest danger, because it was administered in an intelligent manner on strictly scientific principles. In other places where these methods were not understood deaths occurred. Inquiry after inquiry into the reason for these disasters have taken place, all failing to bring the cause of failure to light. Why have these inquiries failed? Simply because the investigators were not qualified to undertake the work. They did not possess the requisite knowledge and therefore did not take the proper steps.

Let me illustrate how this phase of the deficiency in medical knowledge was forced upon me. Shortly after entering general practice I had the misfortune to attend a pregnant woman who died undelivered on account of heart failure. After this melancholy experience I felt that this death might not have occurred if I had had a better knowledge. My teaching had not given me the necessary knowledge. On studying the literature of the subject I found that sufficient knowledge did not exist. The best work on the subject was by Dr. Angus Macdonald of this city, and if you will read the latest obstetric textbooks you will find that practically no advance has been made since Macdonald published his book in 1878.

Finding the literature wholly unsatisfactory, I resolved that I should

undertake the investigation. It struck me no one had a better opportunity than the general practitioner. So I studied the circulatory condition of women before pregnancy, watched them carefully during the whole time they were pregnant, observed them closely during labour and the puerperium, and for months and years after. I studied not only cases with damaged hearts but also many healthy women. After several years I had collected a large mass of material. I found, among other things, changes in the size and position of the heart, murmurs of different kinds, variations in rate and rhythm, and other departures from what is usually considered the normal.

When I came to analyse my observations I found a great variety of signs which needed interpretation before I could find out what bearing they had on the matter. The essential problem had resolved itself into the question of heart failure. Pregnancy in some induced heart failure, so that I wanted to know, did any of these signs indicate heart failure, or did they foreshadow its occurrence? I could not answer these questions. I turned to my text-books for help, I ransacked libraries without avail, till at last it dawned upon me that the knowledge I wanted did not exist. Take, for instance, two groups of phenomena—murmurs and irregular action of the heart. Having detected a murmur or irregularity in a heart, I wanted to assess their value from the point of view of the patient's future, and its relation to heart failure. You must see that no progress could be made to solve the problem till this was done, but I could find no answer to this question.

Having had the lack of knowledge forced upon me in this way, I wondered if I could not do something to shed a light upon this matter. When I started in a somewhat hesitating fashion on this quest I had no idea where it would lead me. Not only did it bring to light many new facts, but it brought to me a consciousness of the deficiency in our knowledge in fields essential to the progress of medicine, and a knowledge of methods by which these deficiencies could be made good, and it is on the strength of that knowledge I have the courage to appear before you to-night.

When I found that I could not get any further in the inquiry as to the danger of pregnancy in heart disease until I was able to assess the value of the phenomena I detected, I took up each of them and subjected them to special study.

Thus, with irregular hearts, I first sought to find out the nature of the irregularities, and found that they were of different kinds. I will not weary you with the steps I took to differentiate one form of irregularity from another; suffice it to say that I became able to recognise and classify the different forms. In later years other investigators took up this subject, and in various ways the physiological basis of the great majority of the different forms of irregularity has been clearly established.

But though this differentiation was a necessary step, it only led me a little way in solving the questions I wanted to solve. What bearing had the cause of the irregularity on the heart's efficiency? Was the irregularity an evidence of heart failure, or did it indicate a condition that under the strain of pregnancy might lead to heart failure? To solve these questions there was nothing for it but to watch individuals who presented the irregularity. My opportunities for this purpose were excellent. By diligent search I found all sorts of irregularities among my ordinary patients. As a family doctor I could keep in contact with them, and watch the young grow up into manhood and womanhood, and the middle-aged pass into old age, and note them during periods of physical stress and while suffering from acute disease. I noted as I went along such incidental signs as might have a bearing upon the individual's health; so that after long years I obtained a knowledge which enabled me to indicate the significance of some of these phenomena, and to assess their value. I do not pretend to have settled these questions, but I have made a slight contribution to the subject, which may help others who may seek to follow this line of investigation.

The Differentiation of Symptoms.—This method of carefully watching the progress of disease brought to light many phenomena which had been overlooked or ignored. By the study of these phenomena a clear conception of the interdependence of symptoms and their significance was obtained. I was struck, for instance, with the fact that the symptoms of disease had never been clearly differentiated on the basis of the manner in which they were produced, but such signs as were recognised were jumbled together in a state of confusion. One of the great hindrances to progress in medicine is this want of clear differentiation in any subject. When I took up this matter of irregular heart action, over thirty years ago, no attempt had been made to distinguish the different forms of irregular heart action on any intelligent basis. We can easily see that before we can assess the value of any sign or symptom it is necessary to separate it clearly and distinctly from others that may resemble it. This may seem such a self-evident proposition as barely to need referring to. Yet quite recently numbers of teachers of medicine have declared in the press that the teachers of thirty and forty years ago knew as much about irregular hearts as we do at the present day. Now this inability to appreciate the first stage in all scientific investigations clouds the whole field of medicine. The symptoms produced by disease permit of a differentiation, based on the mechanism of production, which assists greatly in revealing the features of disease. We have, for instance, a series of phenomena which are recognised by structural alteration of the organ, those phenomena which are included under the designation of physical signs. We have another series of phenomena which are produced by the impaired

functions of the organ, in many instances revealed by effects on other organs remote from the seat of disease. We have another series of phenomena arising from reflex stimulation of the central nervous system—a series often of the greatest assistance in locating the site of the lesion, but which hitherto have received barely any consideration.

Time will not permit me to illustrate how obviously important this aspect of medical knowledge is to the physician and surgeon, and I can but briefly refer to other departments to show how they should be influenced.

The Imperfect Knowledge of Symptoms Reacts upon all Branches of Medicine.—Consider how progress has been delayed in the department of bacteriology on account of this lack of knowledge of the nature of the symptoms of disease. It must be evident to everyone that if bacteriology is ever to have its full influence on medicine, other methods of investigation must be pursued besides those which are undertaken in laboratories. The vast majority of the population cannot have the benefit of laboratory investigation, nor is it necessary that they should have, for this reason, that on the entrance of a microbe into the human body certain phenomena are produced, and these phenomena are peculiar to the individual microbe. We infer, for instance, that measles, scarlet fever, and smallpox are all due to microbic invasion, and although the microbes have not been discovered, the evidences of their invasion are well known. The invasion of the body by other microbes will give just as clear evidence, only as yet we do not know how to search for the evidence. We recognise that a slight rise of temperature usually indicates invasion, and the heart, when played upon by a toxin, may vary in its action, while other parts of the body may reveal the peculiar effect of different microbes. Recent investigations by Dr. Marris have shown, for instance, that in typhoid fever the heart is influenced in a peculiar manner, inasmuch as the typhoid bacillus manufactures toxins whose influence upon the heart resembles that of the digitalis group of drugs. The realisation of this fact opens up a wide field, and from my own experience I know that there is a different reaction produced by the various organisms, and it is imperative that the bacteriologist should come out of his laboratory and study the effects upon the human body of the various microbes.

This aspect of medicine will also, once it is properly grasped, modify the conception of physiology. At present physiology is looked upon as being the most scientific portion of the medical education. The methods employed are supposed to give information so exact that the youthful mind becomes trained to scientific observation. I think it is scarcely realised how crude and limited are all physiological experiments. Methods of exploration which proceed by opening up the body disturb the economy and modify the reaction that must come afterwards; while the stimulus that the physiologist applies is of such an

abnormal kind as Nature never experiences. No doubt the stimulus is sufficient to give a reaction, and this reaction has thrown much light upon the workings of the body, yet the recording of these reactions is, after all, very crude, although the impression prevails that physiological methods are so refined and delicate that the effects of stimulation are carefully recorded. As a matter of fact, it is only the grosser reactions that are detected. In most physiological experiments many effects are produced which are entirely unperceived. If we compare the subtle stimulation that produces reaction in the human body with the results of physiological observation we shall see what I am trying to illustrate. Take, for instance, the reactions of some simple disease, such as a gastric ulcer or an appendicitis. Here we get the effects of a stimulation of the central nervous system; the stimuli are far more delicate, and more in accordance with natural processes, than a physiological experiment. We get pain of a very definite kind, altered sensibility of the skin and other structures of the external body wall, contractions of portions of the abdominal muscle of a peculiar kind, which is scarcely yet recognised, and reflex effects upon remote organs stimulating them to activity. The regions in which these phenomena occur, and the manner in which they spread, point to the fact that there are paths in the spinal cord of which neither the physiologist nor the neurologist have any conception. All these phenomena are lost to the physiologist. You get these signs for instance appearing after a strong peristalsis of some hollow viscus, as gall-stone colic, renal colic, intestinal colic, and all the physiologist has to show is the muscle contraction. These phenomena, though lost to the physiologist, are of the greatest importance to the clinician, because it is by their presence that the varying phases of disease make themselves manifest, and it is only by seeking for such evidence that the knowledge essential for us to understand disease will be obtained. Investigation which reveals these phenomena is absolutely essential for the study of physiology. I do not decry academic physiology, but I do insist that there is also an imperative call for a form of physiology which will recognise the symptoms produced in the human subject, and that the aim of such physiology will be to explain the mechanism by which these phenomena are produced, and such physiology must be guided by the demands of medicine.

If we turn to the field of therapeutics we shall find that advance has been delayed on account of the absence of knowledge of the kind to which I am referring. If I were to make the statement that there has not been a single drug in the whole pharmacopœia, whose effects upon the human body have been properly studied, you would accuse me of exaggeration. Nevertheless it is perfectly true, and the reason is simply this, that the knowledge does not exist to enable any individual to appreciate the action of any drug upon the human body.

In fact, the principles underlying the reaction of drugs have not yet been realised.

This lack of knowledge was forced upon me in my investigations into the action of cardiac drugs. When a general practitioner, I kept for ten years careful notes of all the patients to whom I gave digitalis. When I came to analyse these results I found that digitalis acted in a seemingly capricious manner, profoundly affecting some hearts, and having no effect upon others. When I grouped them together I found that those hearts which were affected by digitalis belonged to very distinct groups. The chief group that was thus affected was recognised by a peculiar irregular action of the heart. I found, further, that digitalis produced irregularities, and that the appearance of these irregularities was of great significance, not only in revealing the effect of digitalis, but in revealing forms of disease in the heart that were unsuspected. Two things were revealed by this investigation—First, that it was impossible to study the effect of any cardiac drug on the heart until the investigator was acquainted with the various forms of irregularity the heart was capable of showing. The second thing revealed from this investigation was, that the action of digitalis was modified by the nature of the disease by which the heart was affected. I want you to grasp the significance of this second principle, because it has never been realised, and its lack of recognition has hampered the progress of therapeutics, and diverted investigation into wrong channels, for this principle is applicable not only to the heart, but to every organ in the body. You can see, for instance, the confusion in the use of the simplest remedies—say aperients. They are rarely given with any consideration of the state of the patient's intestinal tract. It is manifest that such remedies are bound to vary in people with a dilated stomach, pyloric stenosis, dilated colon, adhesions, and so forth.

In another direction this neglect has misled progress. You know advance in pharmacology is supposed to be accelerated by laboratory research into the action of remedies, and the experienced pharmacologist is supposed to be the authority on the action of remedies. In view of the fact that the reaction to remedies is modified by disease, how is it possible he can ever arrive at a knowledge of the action of a remedy on a human being when his opportunities are limited to the organs of a healthy animal?

The peculiar nature of the science of medicine prevents anyone realising how its advance can be made unless he has himself prosecuted definite inquiries and discovered the nature of the lack of knowledge. At this day there are many problems calling for solution, and on account of lack of knowledge we do not even know how to proceed to their solution. Not only that, but I would further state that the profession has such a confused notion of medical research that it does not realise that there are problems to be solved. I do not mean this

in any way to be a reflection on the individual members of the profession past or present, but merely point it out in order that we might grasp more clearly the road which leads to our goal. Supposing one hundred years ago the College of Surgeons had constituted itself into a body to inquire into the cause of suppuration in wounds; that is, supposing the surgeons were so enlightened as to recognise that there was need for such an inquiry, for the first step in solving a problem is to be conscious that there is a problem to solve. We know that had such an inquiry been undertaken, numerous reports and memoranda would have been made, but they would have failed to bring to light the cause of suppuration, for the simple reason that they did not possess the knowledge of bacteriology which was necessary to its attainment.

The Fundamental Fault in Medical Knowledge is Due to Academic Authority.—Turning now from the problems which, if progress is to be achieved, must be solved, let us consider the reasons why these problems still remain. To do this we must study those who are in authority to see if they possess the qualifications necessary for the teaching of medicine. To begin with, we must remember we are dealing with human beings—human beings as teachers and human beings as the taught. It is human to err. If in any sphere of life a few individuals are set apart from their fellows, and given power over their fellows, it is but human that such a select body will seek to aggrandise their position at the expense of their fellows. It is unnecessary to enlarge upon this general statement, as the world's history shows its truth in all spheres of human thought and action. In some spheres it may be good or it may be bad, but in intellectual matters, and especially in science, it can only be bad. In medicine the teachers have practically taken into their own hands the guidance of education and all the intellectual interests of the profession. In the direction of affairs which should influence the teaching of medicine and the prosecution of research the great bulk of the profession are excluded. If you will but glance at the evidence before the London Commission, it seems never to have entered the heads of the Commission, or of the witnesses, that there was a general practitioner's point of view. It is recognised by every general practitioner, who gives the matter consideration, that his education was woefully inefficient. The majority of patients which the general practitioner is called upon to treat present phenomena which he was never taught to recognise, while the diseases themselves are, many of them, quite different from those seen in hospital. The result is, that general practitioners, after they enter practice, have to forget much of what they have been taught, and set about re-educating themselves. Notwithstanding this, teachers whose knowledge of medicine is restricted, more or less, to their special subjects, consider themselves qualified to tell the student who is to

become a general practitioner what is best for him. There is no one in the whole faculty of medicine who, by training, has a sufficiently wide outlook to see the whole series of subjects in their proper perspective. The result is, that each one tends to exalt the importance of his own special subject to the detriment of education as a whole. I will not at present labour this point, but, lest it should be denied, I will give a few illustrations. I referred to the question of pregnancy and heart disease—how has it come about that a problem of such importance has not been solved? Simply because under the present methods there is no body of men with the necessary all-round knowledge capable of solving it. The obstetric teachers know too little of the heart and its manifestations, and the physician has no opportunity to study pregnancy. Or take the problem of the danger of chloroform administration. There is not a class of men in the whole faculty capable of solving it; nay, more, experience has shown that there is not the knowledge necessary to understand the means by which such a problem could be solved. The fact that there are whole fields of medicine absolutely essential to the progress, from which the teaching class are shut off, has never yet dawned upon the academic mind.

The trend of thought at present, as shown by the methods employed in the so-called advanced medical schools, and as shown by the evidence of the witnesses before the London Commission, is distinctly towards a system which will but aggravate the present problem. The cry of each witness is for more laboratories and better opportunities, not recognising how they have failed to utilise the opportunities they already possess. They fancy that their failures are due to an absence of methods, while in reality it is due to a lack of perception of how the aim of medicine can be achieved. They are obsessed by something they call scientific methods, and look with envy upon those schools where laboratories have been provided with a lavish hand. They fail to recognise the absence of that spirit which makes of medicine a science apart from all others, and that medicine cannot be pursued on the lines that may suit other sciences. Take that ideal of training a professor of medicine which prevails in continental schools, particularly in Germany, as set forth in the writings of Flexner and in the evidence of Professor Müller. Here an innocent youth is guided from laboratory to hospital, and inspired by the idea that in this way he can be made a teacher. In course of time he does become a teacher, with an outlook on medicine cramped by his very limited opportunities, and he never realises that he, with his limited knowledge, is supposed to teach men who will go out into the world and see disease in form and degree undreamt of by him. The desire for change of method, with no clear perception of the object, is not progress. When this University of Edinburgh, following the modern notion of

progress, separated from the Chair of the Institutes of Medicine—a chair for purely academic physiology—it was deemed a wise thing. But I want you to be sure of the wisdom. As an investigator in clinical medicine, my work has been hampered all along the line by an absence of knowledge regarding simple physiological problems.

The Opportunities of the General Practitioner to Medicine in General.—Consider for a moment who is the individual in medicine who has the opportunity for a broad outlook, and whose life-work gives him the opportunity of seeing all parts of medical science in its true perspective. It is the general practitioner. He sees the conditions which predispose to disease; he sees its inception and the course it pursues, passing from the signs for medical treatment to the time when it calls for surgical interference. He sees the after-effects of the operation after the surgeon has claimed it as a success. If he is stimulated to inquire into the symptoms of disease, he is brought into contact with every special department, and has the opportunity for estimating them at their true value.

Yet he has no say in medical education or research. If any teaching appointment falls vacant, by the fact that he is a general practitioner he is excluded. Supposing some young physician, with a desire to become a teacher, wants to spend, say, five years in general practice so as to see the diseases his students would ultimately meet with, and to make himself familiar with the opportunities of his future students, we know that such a step, which common sense would dictate, would, under the present conception, disqualify him for a teaching post in any school. I have shown that there are fields of research unexplored which hamper progress, which only the general practitioner can work. What is done for him in research? Money is poured out for research, but no one ever thinks of giving him a grant or instilling into him this aspect of research.

In undertaking this inquiry you will see the need of looking upon medicine with new light in your eyes and the need of a new spirit to guide medical knowledge into fruitful paths. I have been asked to give suggestions as to the methods, but having long studied this matter, I am certain that you cannot perceive the proper paths until you realise where lie the defects of the present. To borrow a simile from the realms of theology, before a sinner is fit for repentance he must be brought to a consciousness of his transgressions. Before you can attempt to reform medical education you must know where it fails, and until you thoroughly understand this the methods to be pursued cannot become clear. I would earnestly ask you, not to accept my views, but to inquire whether what I have said is true. Once you have grasped the aspect of medicine I have presented to you, I have no fear of the result.

Be not too sanguine of a speedy success in your efforts. Many difficulties will confront you, but if your work be honestly and thoroughly undertaken you will have lighted a torch that will illumine the whole realm of medicine.

II.—THE TEACHING OF CHEMISTRY TO STUDENTS OF MEDICINE.

By Professor JAMES WALKER.

In speaking on this subject I labour under the great disadvantage of never myself having gone through a course in Medicine. It might be well, therefore, if I stated at once what experience I have had in teaching medical students, in order that my qualification for dealing with the subject may be estimated.

My first experience of teaching medical students was in University College, London, where I taught not only Chemistry for the First Professional Examination but also Practical Organic Chemistry and Toxicology for the later London examinations. After being appointed to the Chair of Chemistry in Dundee I became a member of the Faculty of Medicine of the University of St. Andrews in 1897, and have since that time sat without interruption on a University Medical Faculty, and so have listened to discussions on medical education for twenty years.

In Dundee the number of medical students was small, and both in lecture and in the practical class these Medical students went through practically the same course as the Science students. There was always the possibility, however, in a small laboratory class, of drawing the attention of students to medical applications of tests and chemical operations which they were performing; so that, although no special training in medical chemistry was formally given to them, they had at least their eyes opened to the connections between the chemistry they were learning and the subjects which they would subsequently take out in their medical curriculum. During the later years of my stay in Dundee I had frequent conversations with the Professors of Physiology and Materia Medica, and thought a good deal about the possible adjustment of a Chemistry course for first-year students which should meet the requirements of these subjects. I became convinced that what the medical student wanted was more Organic Chemistry and less Systematic Inorganic Chemistry.

On coming to Edinburgh I lectured for the first year of my tenure of office to a class of students in the three Faculties of Arts, Science, and Medicine—a parallel course of lectures being given to women students who at that time belonged only to the Faculties of Arts and Science. The Medical Practical Class was taught separately from the First Year's Practical Class for Arts and Science. The experience of

lecturing to a large class of the various faculties, including students of Arts, of Pure Science, of Agriculture, of Engineering, as well as of Medicine, convinced me of the absolute necessity of separating the medical students from the others and delivering a special course of lectures to them. A separation of the two elementary classes was carried out in my second year, and has been adhered to since.

In the Medical course of 100 lectures I have allocated the time in, roughly, the following proportions :—

General Principles of Chemistry	about 25 lectures.
Systematic Inorganic Chemistry	about 30 lectures.
Organic Chemistry	about 45 lectures.

From the beginning I endeavoured to show the students the bearing of the principles and facts laid before them upon the subsequent courses in the medical curriculum. I have found it just as easy to teach the principles of Chemistry and Chemical System by drawing illustrative examples, as far as possible, from Medicine, as by adhering to the time-honoured examples of the ordinary text-books; and I have, by adopting the first method, certainly attained a higher level of attention, interest, and work on the part of the class than I ever did when I adhered to the conventional system. Of course my difficulty has always been the want of direct knowledge of the subjects of the later Professional Examinations. I have had to do the best I could by reading some of the larger modern text-books on physiology and pharmacology, with occasional excursions into books dealing with immuno-chemistry and clinical chemistry. My first object has been to take the student to a point, in Organic Chemistry especially, which will enable him to take up the study of Physiological Chemistry or of the chemical side of Pharmacology without experiencing the existence of any wide gap between his Elementary Chemistry and these subjects. To assist both the students and myself in attaining this end I have written a *Text-Book of Organic Chemistry for Medical Students*, in which I have gone a little further into the subject than I can possibly go in the course of the elementary lectures. Although I am convinced that I have been proceeding on the right lines in this matter, I am very conscious that much still remains to be done to effect the proper co-ordination of Chemistry with the later subjects involving its knowledge.

A course of Practical Chemistry should, as far as possible, run parallel with the Lecture course. Under existing conditions in Edinburgh this is impossible. One hundred students are packed together in a room which could barely provide accommodation for forty. The equipment is of the most primitive description and precludes the use of apparatus with which the elementary student should be familiar. It is quite impossible, for example, to carry out any experiments involving exact weighing—or indeed any kind of weighing at all. All that can

be done, in addition to ordinary test-tubing, is an introduction to volumetric analysis, some simple preparations of salts, and some tests for common organic substances. With a properly equipped laboratory I should be inclined to drop test-tubing altogether, or at least restrict it to a minimum, and give the students practical work which would enable them better to appreciate the lectures.

It is no doubt known to you that an ordinance for the establishment of a Chair of Chemistry in its relation to Medicine is at present progressing by tedious stages to its reception of the Royal signature. Chemistry is now such a large subject and has so many ramifications that it is impossible in a large university for any one man to teach the whole of it, or even to be responsible for that teaching. Nearly every university in England has more than one Professor of Chemistry, and when the subject of dividing the chair was mooted here I strongly urged that the first division should be between medical chemistry and pure chemistry rather than between two branches of pure chemistry, as had been customary. The Medical Faculty here is so large and so important that the teaching of chemistry within it well deserves a head unoccupied by other duties who can devote his whole attention to the medical aspect of the subject. To my mind, the ideal to be aimed at is a Department of Medical Chemistry, which should be in close association with the Departments of Physiology, Pharmacology, Pathology, and Bacteriology, and in which the medical student should be taught not only his First Professional Chemistry, but the chemistry he requires in his later studies. If all this teaching were done in one department under one head, co-ordination and continuity could be absolutely secured, and the student would not have the unfortunate idea that after he had passed his First Professional Examination he was done with chemistry for ever, and that the Physiological Chemistry, for example, he met with in his second year, after a noticeable gap, was something altogether different from his First Year's Chemistry, instead of being a continuation and application of the same.

The difficulty of co-ordination is always great, as I have experienced even in trying to co-ordinate the Lecture Chemistry with the Practical Chemistry, and when two parts of essentially the same subject are taught by different departments the difficulties of real co-ordination in the student's mind are almost insuperable. For the purposes of examination it has been thought necessary to divide medical study into practically water-tight compartments, each of which is presided over by a separate head and has a separate organisation. The necessary result is, that in the student's mind his medical studies form, not a single whole, but a number of different and practically isolated parts. Until this point of view is eradicated progress in the teaching of medicine can only be very limited. In the future I think it will be necessary to give up the system of 100 lectures for a given subject in

one year and 100 lectures in another subject the next year, and so on. These large courses will probably have to be split up into fragments, which must be pieced together again to form some kind of organic whole. Any attempt to carry out such a reorganisation will require a very thorough-going and difficult overhauling and recasting of the student's time-table. It may be practically impossible to reach a condition approaching the ideal, but at least enormous improvement on the existing state of affairs can be effected.

I have stated that I labour under the disqualification as a teacher of Medical Chemistry of never having gone through a complete course of medical instruction. Probably my successor will suffer from the same disability, as it is nowadays practically impossible to get a teacher who is primarily a chemist and at the same time a graduate in medicine. But my successor will have the enormous advantage of being able to devote his whole time to the study of chemistry in its medical aspect, and, by the system I have suggested, of giving all chemical instruction in the one department of which he will be the head, he would be brought into much more intimate contact with the teachers of the more professional branches, realise what their problems are, and, as far as they are of a chemical nature, endeavour to solve them. For unless the new department besides being a teaching department is a research department devoted to medico-chemical investigation, it will fail to reach its full utility, even in elementary teaching.

[A communication on the "Teaching of Physics to the Student of Medicine," by Dr. Cargill G. Knott, Lecturer on Physics, University of Edinburgh, will be published later.]

DISCUSSION.

Dr. McKendrick expressed the opinion that from the point of view of applied radiography he did not see what could be added to the course of physics as at present taught to junior students to help them in the understanding of the X-rays. The practical working of the X-ray apparatus is quite a simple matter—purely mechanical work. The military hospitals are a proof of that; an orderly can be trained within a week to work the apparatus.

On the general question of the teaching of physics Dr. McKendrick thought that more attention should be paid to impressing on the student fundamental principles rather than details. As an examiner in physics he had found that the candidate often has an enormous amount of detailed information at hand, but as to the why and wherefore of it all he is rather lost. It is common experience that by the time a man is qualified to practise medicine he has forgotten a large proportion of his first profession subjects. This is largely due to the fact that he does not appreciate their importance in relation to his later work; the first-year student does not appreciate fully what physics or chemistry are going to be to him in his after life.

Professor Lorrain Smith.—I should like to say something on the

question of the co-ordination of chemistry with the other subjects of the curriculum.

Professor Walker has introduced into our idea of medical teaching an extremely interesting conception of the relation of the subjects. Dr. Knott agreed with him in lamenting the separation of one subject from another, and I think all those who have had experience in teaching will agree with the remarks of both speakers on that point. Thus when there is a practical class and a lecture class in the same subject, you find it is exceedingly difficult to get the students to carry over to the lecture class what they have learned in the practical, and to apply in the practical class what they have learned in the theoretical one. The conception put forward by Professor Walker as to the ideal method of teaching chemistry was not to give a hundred lectures and then a course of practical lessons, but to combine a certain amount of lecture work and a certain amount of practical work together, the one illustrating the other, the co-ordination and continuity being carried out week by week. That principle he has applied still further. Not only should we co-ordinate the teaching of the practical and theoretical work in a given subject, but we should go a step further and co-ordinate the teaching of that given subject—in this case chemistry—with the teaching of other subjects. Professor Walker's method is to me a most illuminating, interesting, and original way of teaching chemistry. The whole curriculum of the medical student suffers essentially from the difficulties which arise from the water-tight compartment system of teaching. I would suggest that Professor Walker's conception should apply to physics also, and that Dr. Knott might deal with this point. In the early stage the teacher would give a general introduction to physics in the time available; and later he should go on teaching the physics necessary for physiology and anatomy, for X-ray work in the interpretation of anatomical structure, and for surgery, etc., etc. That is, that he should teach physics, keeping in his mind the medical point of view. Comparatively few meetings would be all that would be necessary in the later years to keep the significance of the subject fresh in the mind of the student, and to illuminate the new subjects to which he was being introduced; for the real difficulty is in breaking ground. It calls for all the initiative that the average student possesses to break ground in the subjects he has to take up in the medical course. A skilful teacher helps the student over this difficulty of initiative. Of course in text-books you get all the material which is required for teaching, or at least a very large percentage of it; and what the teacher really has to do is to help the student over the difficulty of breaking ground.

Another point I would like to raise is one which I do not think any of the speakers dealt with. We are being bombarded by educational reformers who want us to turn the schoolboy into lines of early scientific study preliminary to medicine. That is a point which I think this club must take up very carefully when considering the early stage of the curriculum. It has been suggested in regard to chemistry and physics that if we could get the schoolmasters to take the burden off our hands, these subjects might be eliminated from the medical curriculum. We must keep in view the question of general education: I would advocate the extension of this in certain directions, and I would be very slow to urge the schoolmasters to displace the study of literature and general subjects, which are the proper work of the schoolboy period. I would leave the serious study of chemistry and physics to the undergraduate of the university.

Dr. Drinkwater.—I cordially agree with nearly everything that Professor Walker has said. My own feeling has always been that there should be a separate course of organic chemistry for medical students. Physical chemistry is also a most important subject; I should put it next to organic chemistry. It is a most difficult thing to make a student understand that the chemistry he is learning in his first year is going to be of any use to him afterwards. I suppose chemistry was originally put into the medical curriculum simply as an excellent science for training the powers of observation. Now it is part and parcel of medicine, but one cannot get the student to see that. He studies it simply to get through his First Professional Examination. Something might be done by an authoritative address to make the student see that he is learning chemistry as part of his medical study and not as a means to passing an examination.

In the extramural school we are up against another difficulty—that of teaching dental and medical students together, their aims and objects being quite different.

One can never teach chemistry in the lecture-room; it can only be really taught in the laboratory. The difficulty is to find the time.

As regards school work. I have had twenty-two years of teaching in a school, and certainly some of the boys have done very well—six or seven are professors in various universities—but I must confess I have felt myself a bit of a fraud all the time. I knew very well those boys had to pass the inspector. I knew what the inspector's little favourite things were, and of course I taught them to the boys! They were supposed to do little experiments and to draw deductions. But a boy cannot draw deductions; he has to be told what the deduction is he has to draw.

Dr. Rainy.—I think that all of us who teach subjects coming towards the end of the curriculum must feel the difficulty in certain parts of side-room work in clinical teaching. The men have got certain facts in chemistry, in physiology, in clinical medicine; but there has been no building of bridges, and the teaching of the one is in no way dovetailed into the teaching of the next. And whilst I do think that with the length of the present curriculum it would be impossible in any serious way to increase the total load upon the student, surely there might be a great deal of readjustment of the load with enormous advantage. It could be brought to bear on what after all is to be the life-work of the great bulk of the students. I quite appreciate the fact that in university and academic teaching we must do something more than train the students for their trade. We must stand for the higher teaching. We have a large number of men for whom, as taking their fees, we are bound to provide equipment for their future ordinary life-work outside academic centres, and I do not think we are doing that in the meantime.

In teaching physico-therapeutics, what I deplore is not so much the student's ignorance of the more remote parts as the want of grasp of the fundamentals. We must remember that when the student first comes to us he is very undeveloped, and it is only afterwards that he understands the value of the subjects in his course.

As regards teaching science in schools, I have never seen any very good results from the preliminary science teaching of boys before they come to university age. I feel that we ought to do more in the way of carrying on from the elementary to the more advanced subjects, either through the same

teacher or through someone else who is very much in touch with the other teachers.

Dr. Kay.—We have heard a great deal to-night about the undesirability of attempting to teach the schoolboy science. My own experience is that I should have felt myself rather at a loss if I had had no instruction at school from a good teacher. I think that we are not yet in a position to assume that all our students have been well taught at school, but I should doubt very much whether under present university tuition conditions the student who has had no school teaching will excel, at least in, for instance, chemistry. I should like very much to know whether the students we have who do well in chemistry are those who came to the subject as an entirely new one, or whether they have, as a rule, already had a fundamental training at school.

I am quite in sympathy with what has been said about us teaching far too much in the course of the first winter. Something must be dropped.

Dr. Dingwall Fordyce emphasised the importance of impressing upon the student at the very beginning of his studies the interdependence of the different subjects of the course, and particularly the bearing of the more purely scientific subjects on clinical work. Without this the beginner has no conception of the ramifications of medicine. This might be done by means of an introductory address by an eminent clinical teacher, who would arouse the interest of men who are taking up medicine as their life-work, and give them some conception of what the study of medicine implies.

Dr. J. S. Fraser.—What has been said shows that we must go back to an earlier stage than the first year of the medical student—to the school curriculum. English often forms a very small proportion of what is taught at school. Far too much time is taken up with Greek iambics and Latin prose. I think that in this discussion we ought to call attention to the fact that the modern school education is anything but satisfactory for the schoolboy of 17 or 18 as an introduction to medicine.

It is desirable to spread such subjects as chemistry and physics over the whole medical curriculum, so that when the student comes to diseases of the eye, say, he should know something about optics, and when he comes to diseases of the ear he should know something about acoustics. The student would then receive the information at a time when he would appreciate its importance, whereas in his first year he fails to see that it has much connection with his subsequent career.

Dr. Taylor.—I happen to have been one of those unfortunate individuals who inspect the teaching of science in schools, in addition to teaching in the university. I may say that the teaching of science in schools has changed very considerably since Dr. Drinkwater taught in schools. It is done in quite a different way in a great many schools, and it is almost invariably the opinion of headmasters that the boys best at other subjects are those who are best in science. In visiting the greater number of secondary schools in the southern district of Scotland and in conversing with the headmasters and teachers whilst examining the boys and girls, I have formed a strong opinion that the scientific side of the school is the best side nowadays, and it is my experience that the boys and girls I have examined in previous years at school and noted as being very good in science are those who have figured pretty well in the

honours list of the university. I think it is the fashion to run down the teaching of science in schools just now, especially among those who are interested in medical education. This seems to me very unfortunate. The time given to science is usually taken from Greek, so that the boy taking science gets the same English education as the other children. I am sure everyone who has taught science in the university, especially to medical students, knows that there is a very real difficulty in making them realise the importance of science and in getting them to understand that when they have done with physics in the first year they have not done with it for ever.

I think only those students who have had a reasonable education in science at school have much chance of knowing anything about it at the university. The only hope of progress lies in Professor Walker's suggestion of co-ordination, and that teachers of physics should have a further opportunity of holding classes after the first year. As a university teacher I can say that my experience as an inspector under the Scotch Education Department did me a world of good, in that it showed me the kind of work they were doing in the schools and revealed the gaps and overlappings between school and university teaching. I am sure it would be of benefit to both if the university teacher knew what his pupils have been through before they come to him.

Professor Ritchie.—The discussion we have had to-night already justifies the club in inaugurating what I hope will be a very serious task of this winter. In the discussion of two elementary subjects we have come up against fundamental principles, and it is obvious that there are a great many difficulties with regard to these principles which we will have to face. The question of the preliminary education of the students who come to the university is one of these fundamental points, and one which I think this club will have to take up more in detail. I think it will be necessary for us to have some conference with the authorities in preliminary education as to the part which school education can play in preparing for the medical curriculum. It seems to me in regard to this matter that the water-tight compartment of which Professor Walker has spoken has operated very detrimentally. There has been no proper co-ordination between the people who are responsible for arranging the preliminary education and the people responsible for carrying on and elaborating that education in the training for the medical profession. We have to face the fact that we are not only dealing with boys and girls who have been subjected to the Scotch educational system, but also with those who have gone through a certain preliminary education elsewhere. It is practically impossible to devise an advanced course of instruction suitable to the requirements of all the various classes of students who come here, and I think, in the first place, that we should lay down the fundamental principle that we are to adjust our university courses to the requirements of Scotch boys and girls—and if possible English boys and girls—and leave the others to see that they have to come up to these requirements. The tendency is to raise the school age and to have students coming up to the university at a more advanced age than hitherto.

With regard to science, the question arises—At what age can science begin to be properly appreciated? That, too, is a fundamental point. I do not think that up to the age of 16 or 17 the average boy or girl is capable of drawing the deductions necessary for the proper understanding of science.

I think everyone will agree that the recent work done by Professor

Walker in bringing to the forefront the necessity of having a special teacher of chemistry devoted to medical students is going to be of the highest value, and that it gives us in the meantime an outline of how a preliminary subject can be carried right through the course. Perhaps the scheme would be more easily applied to chemistry than to some other subjects, because I think the student will appreciate more readily the universal bearing of chemistry on all his work than the universal bearing on it of the other individual subjects. He sees, for one thing, in the curriculum that he has to attend courses of physiological chemistry. I hope that he will soon see that he has got to attend courses in more advanced chemistry, or, rather, later courses in chemistry, which will deal with the clinical and pathological sides of chemistry.

I should like to hear how the subject of physics should be expanded, and how far the suggestion thrown out that as in chemistry so in physics, in the later parts of the course, particular aspects of the subject should be dealt with.

Of course the whole curriculum is rendered difficult of approach from the fact that you cannot get out of the mind of the student the idea that the be-all and end-all of attending classes and going through courses is the passing of examinations. That is another fundamental question that we must face in this discussion. I think that Professor Lorrain Smith will agree that when they come to pathology the students are still as elemental in their views as when they come to chemistry. They do not appreciate the difference between education and the passing of examinations.

Professor Russell.—I should like to say a few words on what we have heard about the co-ordination of physics and chemistry with anatomy and physiology. The practical outcome of such a scheme would seem to be that more attention would be paid early to anatomy and physiology and, if I understand Professor Walker aright, to take in a certain amount of more advanced chemistry along with physiology; and that physics would come in to a certain extent in physiology but would be taken also in later subjects of the curriculum. As a teacher in one of the more advanced subjects I sympathise with almost everything that has been said. It would be a great gain if the student could be carried on in that way to the important departments of science as now so definitely applied to practical medicine. Of course we have to be careful not to overload the student, but there is no doubt that the trend of modern education has been to make him desire to get up tables and pure memory work. The average student, so far as I know him at present, very much objects to having to think about things. I have spoken about this with many educationalists, and they have assured me that I am not mistaken. Indeed, I am amazed at the development of the modern memory. From school-work it has been carried on into medicine, and the student wants to have a certain definite set of things that he must know in chemistry or physics, or any other subject; he does not want to think about them at all. That, of course, touches the important matter which Dr. Drinkwater dealt with—the teaching of principles and the getting of students to look at and understand their subjects and to make deductions from what they see. I also account for the student's attitude of mind, at any rate in the earlier stages of the curriculum, by the new system of examination. When I was studying medicine we had to attend for two summers and a winter or for two winters and a summer before we were allowed to go up for any examination. If we

began in summer we had botany and zoology, and we could not go up until the end of the next summer, with the result that we went over these subjects again during the second summer, the outcome being that we undoubtedly carried away with us certain principles at all events and a certain amount of broad knowledge that we have never forgotten Think of what happens now. A boy leaves school, and begins his medical course in summer with botany and natural history. At the end of ten weeks he is expected to pass in botany and natural history; and he does so. What could happen but that he should forthwith cast them and forget them completely!

MR. MILES.—It is very fortunate that thus early in our discussion we have taken up the line of co-ordination of subjects. Such a scheme would to some extent break down the water-tight compartment arrangement; it would no longer be water-tight if the professor of the first year had a part to play in the second, third, and subsequent years. Co-ordination of this sort would to some extent do away with the difficulty of school education in scientific subjects. The question of the examinations is also important, because to the student the examination is the essential point, and until we can get rid of that idea little can be done. We must consider in what way we can modify the examinations so that they shall be a real test of the student's knowledge right through his course. There are various ways in which this could be arranged, but this is not the time to discuss them.

PROFESSOR ROBINSON.—One thing that comes out of this discussion is that everybody is agreed that water-tight compartments must go. It is perfectly obvious how they began. To arrange examinations and time-tables was the easiest way of making a curriculum; and it is possible to get more memory work into a given number of weeks if you make water-tight compartments than it is if you spread the work out into a dovetailed curriculum. I agree with everything that has been said about the dovetailed system and with everything that has been said about the preliminary education through which our students go before reaching the university; I am in absolute disagreement with the idea of any preliminary scientific education for medical students. I agree that medicine is purely utilitarian, but I disagree that you must start with principles straight away. I think that what is now preliminary should come later. You must start from something the man knows. There is no use in discussing general principles with him—he does not know what you are talking about. But if you teach him to appreciate what he does know about himself and then pass on to the explanation of the phenomena of that which occurs within himself, enlarging his scientific conception of what he knows, then to my mind you will have begun in the only right way. Having brought him up to pathology, anatomy, etc., we should pass back to zoology and other earlier subjects, and explain how each subject affects and bears upon the other. Taught in this way he will take an appreciative interest in the matter. If I talk to him about muscles or bones, and tell him that certain things will happen if these are broken, he will appreciate it at once. Dr. Knott's levers and other forms can be explained on those lines. I think that, going on those lines, we would get far more out of the student than it is at present possible to do.

DR. EDWIN BRAMWELL.—We who are teaching the student just before he graduates ought at any rate to realise what he requires to know in his

profession afterwards. I think the lack of this knowledge is perhaps the fault of the clinical teacher, and I think that if clinical teachers met together and formulated certain ideas of what they want the student to know before he comes to them much might be gained.

Dr. McKendrick.—In our curriculum it would be an advantage if those lecturers who are teaching towards the end of the course could say to the earlier lecturers, "The men you send up to me must know about so-and-so. I want them to understand this and that in anatomy, physiology, pathology, and so on." With such intercommunication among the lecturers and teachers from the final year downwards those of the first year would have a better chance to prepare the student for what he is coming to in his later lectures.

Dr. Sillar.—I have had peculiar opportunities of forming opinions on this subject of co-ordination among the lecturers, because the subjects that I have had to teach touch in many points on the teaching of the First Professional subjects, and perhaps I may be excused for saying in passing that of late years it has struck me forcibly that the equipment of the average medical student in chemistry shows a much higher level than it did in the years when I first began to teach. I think that this was coincident with Professor Walker's appointment to the Chair of Chemistry, and I am sure that, owing either to the way in which he treats the subject or to some power of his own of really impressing students with the importance of chemistry, we do not now get the same ignorance with regard to fundamental chemical facts which was an ordinary experience when I began to teach.

I also have been impressed with the medical student's inability to observe. He cannot observe, and when he tries to he cannot record his observations in accurate language. The point, I think, has to be faced as to where in his curriculum this fundamental part of a student's training must be laid down. I sometimes find, for instance, that they have not an elementary knowledge of how to weigh ; they never have weighed, they do not know the method of manipulation of a balance. Further, in reading the cases taken by the students in the Infirmary, I have found the same want of power of observation. I have also had rather a peculiar opportunity of investigating the question of examinations and the interest a student takes in his work, because it is my fortune to teach a class in which there are no examinations, either class or professional. The only men who ever take the class of experimental pharmacology are men who really want to learn something about this particular subject. Although there are very few men who take it, I have never had to complain of want of interest. And I think—I do not know if it is a counsel of perfection—that if we were able to omit the examinations and to a large extent to pass students from one subject to another on the knowledge that the teacher has got of their work while it comes under his particular care and observation, we would gradually eradicate that extraordinary point of view which one is always running against, that the student is not only preparing for an examination, but that the examination is one long-continued piece of elaborate trickery. One tries to get rid of this idea and to impress upon the student that when one asks him a question which has a reasonable answer it is that answer one wants. But the more elementary the question the more will a student hesitate to answer, because he cannot believe that he is going to be asked a question with a reasonable answer. I

think that this water-tight compartment system—where each examination is a milestone upon which the mental view of the student is fixed and on passing which he breathes a sigh of relief—vitiates from the beginning his power of mind, so that he cannot appreciate why he is learning the different subjects. There is no doubt as to the advantages of the correlation of the teachers.

Mr. Jardine.—In the Surgical Out-Patient Department I see the student in his second year when he first comes into contact with the living person in the hospital, and he shows extraordinary interest in the patients and a keenness to learn everything about them. Then he leaves for a year to work at the subjects of his Second and Third Professional Examinations, and on his return to hospital in his third or fourth year his outlook as regards the patient is completely changed ; he takes little interest in him. Is there no way in which we can bring the student at an earlier period into contact with the patient and carry that on throughout the years until he qualifies ?

Dr. Byrom Bramwell.—This discussion shows how difficult the subject is, and how difficult it will be to make alterations of a practical nature which will not only improve the teaching of medicine but will please individual lecturers and teachers.

The first fundamental point which ought to be considered when approaching a discussion of this sort is : What is the object of medical teaching ? I take it that the object is to turn out medical men who are able satisfactorily to practise their profession. This great University of Edinburgh has always been a teaching centre of that kind, aiming at turning out practical medical men rather than researchers and professors. Of course it is important at the same time to aim at still higher teaching for men who show the ability and the wish to profit by it. But this certainly is not the *main* object of medical education. Thus we have great difficulty in so co-ordinating the curriculum that it will suit the average medical student, and at the same time teach the men who are aspiring to higher things. We must look at this as practical men, and consider the class of students who come up. The average man has only average abilities, and the higher teaching for him is quite wasted. Of course the ideal thing would be for everybody to be a complete chemist, a complete physicist, and then to begin the study of practical medicine. But life is short, and it is impossible to attain this, so that all that we can do is to endeavour to make a practical course which will be fitted to the average student, and will at the same time stimulate the more intellectual man to do better things afterwards.

I should like to see botany and natural history completely done away with in the medical curriculum, and passed before a man came up to the university. The average student cannot possibly grasp in the time at his disposal all that he has to undertake. I would like to see a great number of the systematic lectures done away with ; more attention even than at present should be paid to practical work in the laboratory and in the hospitals.

The lecturer ought to emphasise the important points in those scientific subjects which are going to be of use to the medical student afterwards.

For each of the subjects there ought to be a certain series of subjects drawn up, and the student should be told that those are the subjects on which he will be examined. The object in teaching the preliminary sciences is to

make the student learn something that he will remember all his life and which will be useful to him in the future practice of his profession as well as in learning it. Instead of examining a student over the whole range of a subject, emphasise certain things and tell him these are the things he *must* know. In medicine itself an enormous amount of superfluous and entirely useless matter is taught. If the student meets a rare case he has his text-book to go back to. Let him know certain things well rather than the whole imperfectly. This must be settled by a consultation of teachers who know what is wanted, and who will be able to judge of the relative importance of each subject. I was very much interested in Professor Walker's suggestion of co-ordination.

The subject is of great importance, because I take it we are not trying to legislate for this school alone, but are trying to lay down an altered system of medical education which will be a real improvement all over the country.

Professor Walker said in reply—With regard to my experience of the value of school instruction in chemistry, if you look at the list of first-class honours' men you find that the majority have had previous instruction in school, no doubt, but when you take the class as an average, I am not so sure about school education. On one occasion I had a particularly large class in chemistry—for Arts and Science, not Medicine—and I ascertained from direct inquiry the number of years of school chemistry each individual had had. I divided the class into two sections—those who had had over three years and those who had had under three years at school—and in the end there was very little difference in their work.

I should be prepared, if I had the proper laboratory, to drop nearly all the lectures and make the instruction almost entirely practical.

One of the great drawbacks of the hundred lecture system is that the instruction is far too concentrated. It is really marvellous what the average medical student learns of chemistry in five months. But he would learn to very much better advantage if the same lectures were delivered over a longer time. I know that by experience. I have two classes—a normal elementary one for medical students and one for science students. The medical class is compressed into the winter session ; the three times a week science class spreads over three terms, and there is no doubt that the science people do very much better on the average than the medical people. If we could arrange our medical curriculum more on these lines, even without the co-ordination I have suggested, a far more satisfactory result would be obtained.

OBITUARY.

ELSIE MAUD INGLIS, M.B., C.M.

Towards the end of November a cable from Archangel brought to the friends of the Scottish Women's Hospitals the welcome news that Dr. Elsie Inglis and her unit were on their return journey from the south of Russia. Although the message indicated that Dr. Inglis was not well, and would be obliged to rest after her return to this country,

no great anxiety was felt, and even after the arrival of her ship at Newcastle on Friday, the 23rd, she sent messages to her friends which gave no indication that her health was so far from satisfactory. Then came a disquieting message on 26th November; and on the morning of the 27th her friends had the sorrow of learning that Elsie Inglis had passed away.

Elsie Maud Inglis was the second daughter of Mr. John Forbes Inglis, I.C.S., Chief Commissioner of Oudh. She was born in India, and was educated in Edinburgh and Paris. Her medical education was for the most part received at the Edinburgh School of Medicine for Women, founded by Dr. Jex Blake, but Miss Inglis was one of the women students who was instrumental in the opening of a second school of medicine for women in Edinburgh, which was known as the Medical College for Women, and it was with the fortunes of this school that she was more closely associated. After completing her clinical work in Glasgow she took the Triple Qualification in 1892. She then worked for a short time as house surgeon in the New Hospital for Women in London, and subsequently took up practice in Edinburgh. After the University of Edinburgh admitted women to the examinations for Degrees in Medicine, Miss Inglis took the necessary additional classes and graduated M.B., C.M. in 1899. She thereafter continued to practise in Edinburgh, and worked in partnership with the late Dr. Jessie MacGregor until Dr. MacGregor left Scotland to take up work in America.

Dr. Inglis was largely instrumental in the opening of the Hospice in the High Street of Edinburgh as a nursing home and maternity centre staffed by medical women. The need for this institution partly arose from the fact that medical women are not eligible for posts in the Edinburgh Maternity Hospital, and the Hospice has well justified its existence, although up to this time the work has often been hampered through lack of sufficient funds.

Subsequently, Dr. Inglis was appointed Joint-Surgeon to the Edinburgh Hospital and Dispensary for Women and Children, and she was working actively in connection both with this institution and with the Hospice when war broke out. She was also recognised as a Lecturer on Systematic Gynecology in the School of Medicine of the Royal Colleges, Edinburgh.

Dr. Inglis was keenly interested in surgery, and a few years before her death visited various surgical cliniques on the Continent and in America in order to gain a wider knowledge of surgical procedure. Surgery and the development of maternity work in connection with the Hospice were the subjects in which, from the professional point of view, she was chiefly interested, but her professional work had always to share her attention with many outside interests. She was a keen politician—in the pre-war days a staunch supporter of the Liberal

party—and in the years immediately preceding the war she devoted much of her time to work in connection with the Women's Suffrage movement. She was instrumental in organising the Scottish Federation of Women's Suffrage Societies, and was Honorary Secretary of the Federation up to the time of her death.

To her friends Elsie Inglis is a vivid memory, yet it is not easy clearly to put in words the many sides to her character. In the care of her patients she was sympathetic, strong, and unsparing of herself; in public life she was a good speaker and a keen fighter; while as a woman and a friend she was a delightful mixture of sound good sense, quick temper, and warm-hearted impulsiveness — a combination of qualities which won her many devoted friends. A very marked feature of her character was an unusual degree of optimism which never failed her. Difficulties never existed for Dr. Inglis, and were barely so much as thought of in connection with any cause she might have at heart. This, with her clear head and strong common sense, made her a real driving power, and any scheme which had her interest always owed much to her ability to push things through. But probably the factor which most greatly contributed to her influence was the unselfishness of her work. She truly "set the cause above renown" and loved "the game beyond the prize." She was always above the suspicion of working for ulterior motives or grinding a personal axe. It was ever the work, and not her own share in it, which concerned her, and no one was more generous in recognising the work of others.

On the outbreak of war Dr. Inglis offered herself to the War Office, but her services were declined, and she thereupon determined to find military work for herself and other medical women placed in a similar position. Her project of organising a hospital staffed entirely by women was supported by the Scottish Federation of Women's Suffrage Societies, and the Scottish Women's Hospitals for Foreign Service came into existence. As the military authorities in this country did not at that time see their way to accept the services of medical women, or to make use of hospitals organised on such lines, the hospitals were offered to the Allies, whose medical organisation at the beginning of the war was very inadequate, and in the later months of 1914 the first units of the Scottish Women's Hospitals went to France and Serbia.

Dr. Inglis did not at first go out, but when in the spring of 1915 Dr. Eleanor Soltau, who was in charge of the First Serbian Unit, became ill with diphtheria in the middle of her struggle with the typhus epidemic which was then raging, Dr. Inglis decided to go to Serbia to allow Dr. Soltau to return to this country. She remained in Serbia, directing and developing the work of her unit until the Austro-German forces overran the country. She was taken prisoner with

others of her unit, having decided that it was her duty to remain at her work. After some months the British hospital units were released, and Dr. Inglis and her party returned to this country viâ Switzerland. On her return to Scotland her friends were somewhat anxious with regard to her health, as she had grown very thin, and was obviously in need of rest, but she was full of plans for the future, and could not be persuaded to take a holiday. At that time her great wish was to organise a unit for Mesopotamia, but as facilities for this scheme were not forthcoming she acceded to the request of the Serbian authorities that she should take a hospital to Russia to work with the First Serbian Division attached to the Russian Army. She sailed with her unit to Archangel in the end of August 1916, proceeded at once to the south, and had just got to work in the Dobrudja when the fortunes of war turned against our Allies and the hospitals were compelled to retreat, along with the armies and the refugee population of Rumania. The experience of this retreat was a trying one, and it says much for Dr. Inglis' leadership that she brought her personnel and equipment safely back to Russia. After the retreat the remainder of the Serbian Army was sent back to Russia to rest quarters, and Dr. Inglis' hospital was lent to the Russian Red Cross until required again by the Serbs. Under this arrangement she worked at Reni until in the summer of this year she again joined the Serbian Division. By this time, however, her health was unsatisfactory. She suffered from recurring attacks of dysentery, and for five weeks at her next camping-place she was confined to her tent, but she refused to consider coming home until certain important negotiations concerning the welfare of the Serbian Army were completed, and during this time she gave strict orders to the members of her unit that her illness was not to be referred to in home letters. In the same spirit she refused to take advantage of house accommodation for herself in Russia when the cold weather began, insisting on continuing to share the same discomforts as the others of the unit who were under canvas. When the time came to begin the long homeward journey north from Odessa, it was a question whether she was strong enough to travel; but she decided to go on, and her staff had to content themselves with making her as comfortable as was possible under the circumstances. She was seriously ill at more than one point during the journey, but after embarking at Archangel she apparently improved somewhat at first, and once or twice was able to join the unit at lunch. It does not appear that Dr. Inglis herself anticipated a fatal termination to this illness, for before reaching Newcastle she had an interview with the Serbian officers who were travelling in the same boat, and arranged to have a meeting with these gentlemen in London soon after arrival in this country. By this time, however, she was beginning to realise that she herself would not be strong enough to take her unit out again

immediately after refitting, as had been her intention. On arrival at Newcastle on 23rd November the weather was very stormy, and the party was not allowed to land until the 25th. Soon after reaching her hotel on the evening of the 25th her illness suddenly took a more critical aspect, symptoms of peritonitis supervening. On Monday, 26th, it became apparent that her condition was hopeless, and she died on the evening of that day, being conscious until a few minutes before her death. Up to the end her mind was full of plans for future work —plans mainly for the help of the Serbs, and particularly the Serbian Division to which her hospital had been attached. When she realised that the carrying out of these plans was not to be for her, she spent the last hours of her life dictating messages to her committees, as well as to personal friends, and in a very wonderful way appeared simply to readjust her mind to the new set of circumstances—did what she could to make clear the lines on which her former work should be carried on, showing not a shadow of doubt that all would go well, and that the work would be done—and then turned to the new door which had so suddenly opened, serenely looking forward to new work in the future. Just a few minutes of unconsciousness and she had gone forward, leaving with her friends nothing but happy memories of those last hours, and an insistent conviction that the Elsie Inglis who had been so living in her personality here was still living, working, planning—in her own keen way—somewhere, just out of sight for a time.

Beatrice Russell.

RECENT ADVANCES IN MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

EDWIN MATTHEW, M.D., AND JOHN EASON, M.D.

Chronic Intestinal Stasis—Medical Treatment.

Hayes (*Int. Med. Journ.*, March 1917) discusses briefly the symptoms, signs, and treatment of this common condition. He quotes Lane as dividing cases of chronic intestinal stasis into three groups from the point of view of treatment. Ninety per cent. of cases are suitable for medical treatment; another group requires corrective surgery—freeing of bands, kinks, etc.; while severe cases require short circuiting.

Cases of intestinal stasis are characterised by well-known symptoms—headache, indigestion, epigastric pain or discomfort, constipation, even though the movements may be regular or even loose. There is dizziness, depression, weakness, etc. Physically they show pallor, sallow skin, diminished weight, cold extremities, ptosis of stomach and intestines

and gastric wall atony. The duodenum is dilated with gas, the left iliac colon is frequently spastic, and the ileo-cæcal valve is incompetent. Hayes describes special signs in these cases helping a diagnosis of dilated duodenum, sagging of jejunum, and incompetence of the ileo-cæcal valve.

1. The presence of a dilated duodenum determined by light percussion over the first part and percussion with pressure over the second and third portions of the duodenum.

2. Pressure paradox—the emptying of the dilated duodenum when the anterior abdominal wall is lifted backward and upward by pressure exerted below the umbilicus.

3. Inflated ileum—tympany over the ileal coils when the escape of the contents is unduly retarded from any cause.

4. The determination of incompetence of the ileo-cæcal valve by first massaging the gas from the ileum into the colon, then pressing with the side of the left hand across the mid portion of the ascending colon, and then exerting gentle pressure with the right hand over the cæcum. If the valve is functioning normally the contents are not returned to the ileum.

Also in a thin-walled abdomen the corded transverse and left iliac colon are readily palpable.

These special signs described by Hayes he holds are not found in normal persons, and their disappearance follows improvement or cure of the intestinal condition.

Medical Treatment.—1. Raise and maintain in position the intestines. This is best done by a good belt, spring support, or corsets. It is important that it be really effective. In addition, patient should attempt to carry his outer self with chest forward, shoulders back, and abdomen drawn in.

2. Regulation of bowels and quickening of current, particularly in small intestines. Do not employ methods that will irritate mucous membranes. Massage, special exercises to strengthen the abdominal muscles. A glass of water should be taken an hour before each meal and at bed time. Heavy liquid petroleum before each meal. Cascara and phenolphthalein are both of use.

3. Correct and aid the secretory and motor function of the stomach. Test meals will indicate what correction is necessary—alkalies or acids, etc.

4. Check putrefactive changes and excessive fermentation. This is very often difficult to do. Irritant articles of food and drink to be entirely avoided. Keep urine free from indican, and avoid gaseous distension.

5. Improve constitutional condition by proper exercise; employ massage, hydrotherapy, etc.

Albuminuria and Hæmaturia Following the Administration of Hexamethylenamin.

Wiseman (*Amer. Journ. Med. Sci.*, August 1917) records five cases in which hexamine administered for various conditions produced urinary irritability, with albumen or blood or both in the urine. Recently this drug, following its success in certain bladder conditions, has been widely employed in many infections. After absorption it is converted into ammonia and formaldehyde. The latter is formed only in an acid medium, and as such only exists in urine, gastric juice, and sweat, it can really only be efficacious in these secretions. Three conditions are necessary for the formation of formaldehyde—concentration of the drug, duration of its action, and acidity of the medium. Such conditions exist only in the bladder. When urinary irritability appears as the result of giving hexamine it is the result of insufficient dilution of the drug, high urinary acidity, or idiosyncrasy. The symptoms vary from increased frequency of micturition to severe vesical tenesmus or even strangury, albumen or blood often being present. The blood is from the bladder, but the source of the albumen is doubtful, and may be from the kidney. From his observations he concludes that the cause of the albuminuria or hæmaturia is abnormal by high urinary acidity. In four of his five cases the acidity was over 100, and it is necessary in administering hexamine to ascertain the acidity of the urine. If the acidity is too low the drug is inefficient, and if the acidity is too high irritative phenomena may appear.

Newer Aspects of Infection in Pneumonia.

Steinfield (*New York Med. Journ.*, 14th April 1917) has a short but important paper summing up certain new facts in pneumonia which are essential for its proper understanding.

1. Pneumonia exists in four types—I., II., III., IV. Pneumococci of type I. produce a homologous antiserum which protects white mice against lethal doses of cultures of type I. Serum of this type will not protect against infection with type II., and *vice versâ, i.e.*, type II. has its own antiserum. Type III. is the pneumococcus mucosus. No serum has been obtained for it. Type IV. includes all other strains of pneumococci. These facts explain why unsatisfactory results have often been obtained in pneumonia by use of sera. For success the type must be first ascertained. The worst cases of pneumonia are due to types II. and III. There is less fatality from type I. and the mortality from type IV. is less than 10 per cent.

2. *Transmission of Pneumonia.*—Pneumococci have been recovered from the mouths of patients who have had pneumonia as long as ninety

days after the beginning of the illness. Those attending pneumonia cases have shown on cultural examination the same type of organism in the mouth as the patient, and transmission is therefore possibly from person to person by coughing and sneezing.

3. *Mechanism of Infection.*—Pneumonia is a bacteremia. The lung lesion is merely a focal sign of bacteremia, and the amount of lung involved is no criterion of the amount of infection. The toxins are not soluble as in diphtheria, but are endotoxins liberated when the coccus is broken up and digested in the body. Agglutinins are the defence, and these have been found in the blood of pneumonia patients of types I., II., and IV. Patients who recover have a short period of active immunity, and their sera protect white mice from infection with the same type of pneumococcus. The protection is non existent in two or three weeks.

4. *Pneumonia Carriers.*—As patients retain virulent pneumococci some time after recovery they should not be discharged until negative reactions are got from the mouth, and physicians and nurses should be careful of oral cleanliness.

The Nervous Symptoms of Polycythæmia Vera.

Christian (*Amer. Journ. Med. Sci.*, October 1917) discusses ten cases where nervous symptoms were present, and he does so because such nervous phenomena have led to mistaken diagnosis and even to cerebral operations. Patients with polycythæmia vera are often not abnormally cyanosed, and may even show pallor due to vaso-constriction or peripheral circulatory failure. With nervous symptoms predominating the diagnosis is not made. The majority of cases described in literature showed nervous symptoms. The commonest were vertigo, fulness of the head, headache, pain and prickling sensations in the extremities, ringing in the ears, staggering gait, muscle weakness, and blurring and other disturbances of vision. In Christian's ten cases the most frequent nervous symptoms were headache and dizziness. Next common were disturbances of vision, often temporary, transient blindness, hemianopsia, and diplopia. Paresis and paralysis of various parts were also found. These nervous symptoms are the result of disturbances in the central nervous system. Post-mortem vascular thrombosis was found in some cases, arising partly from disease of the vessel walls and partly due to the changed condition of the blood. Areas of cerebral softening were found in another case, without thrombosis or lesion in the vessel wall.

It was peculiar that all Christian's cases occurred in persons between the ages of 50 and 60. He suggests that the blood condition may exist for a long time before such definite symptoms appear, and this is supported by the fact that high blood counts indicative of polycythæmia occur among members of families and no symptoms are present.

Chronic Heart Block.

Blackford and Willius (*Amer. Journ. Med. Sci.*, October 1917) record their observations in nine cases of chronic heart block. In four of these cases they claim to have been successful in undoubtedly relieving the symptoms and obtaining an increase in the idioventricular rate by the use of a drug not hitherto employed in cardiac therapy. Symptoms in heart block—the so-called Stokes-Adams syndrome—are caused by cerebral anæmia due to temporary stopping of the ventricles or to little runs of rapid contractions which are inefficient in their pumping action. For the treatment of the Stokes-Adams syndrome something is required which will increase the idioventricular rate. Thyroid extract increases the heart rate in normal individuals, and in hyperthyroidism one of the classical features is the tachycardia. Acting upon this, the authors in four cases employed alpha-iodin, the active constituent of the thyroid recently isolated by Kendal. The administration was followed in these cases by an entire cessation of Stokes-Adams attacks, by increased ventricular rate, and marked improvement in the general nutrition.

They summarise as follows:—

1. Alpha-iodin quickens the idioventricular rate in complete heart block. This is followed by marked subjective relief to the patient. The drug must be pushed to the tolerance of the patient and the dose then reduced to the largest amount that can be taken without discomfort. The auricular rate increases much earlier and to a much higher figure proportionately than the ventricular rate.

2. We do not know the effects of long-continued administration of large doses of alpha-iodin in patients not suffering from thyroid insufficiency, therefore we believe that for the present this medication should be used only to relieve the Stokes-Adams syndrome in heart block.

3. In nine cases of complete heart block eight patients gave evidence of definite valvular disease, mitral disease predominating; the ninth patient had advanced nephritis.

4. In none of these nine cases was there a probable venereal etiology.

5. Six of the patients gave a history of probable etiological infections with the streptococci group. Diphtheria seems to have been responsible in two cases.

6. Digitalis should be used in all cases of chronic heart block in which there is evidence of myocardial insufficiency. E. M.

SURGERY.

UNDER THE CHARGE OF

D. P. D. WILKIE, F.R.C.S., AND JAMES M. GRAHAM, F.R.C.S.

The Treatment of Gunshot Wounds of the Larger Arteries.

Leucert (*Lyon chirurgical*, July to August 1917) describes the treatment of gunshot wounds of the larger blood-vessels.

The immediate prognosis depends on the extent of the wound in the skin. If the superficial wound is large, death occurs as a rule, but if it is limited or narrow, the blood may be mainly effused into the tissues around the vessel. In a certain number of cases the amount of hæmorrhage is insignificant, due to spontaneous hæmostasis.

Spontaneous hæmostasis is seen more frequently in cases of complete section than in lateral wounds, and particularly when the vessel has been contused and the internal coat has been torn. The author has observed spontaneous arrest of hæmorrhage in twenty cases of wounds involving the axillary, femoral, and popliteal vessels.

The temporary application of a rubber tourniquet at the first-aid post should only be made in cases where it is obvious that the hæmorrhage is from a large artery, as the ischæmia and constriction of the limb favour the onset of gas gangrene in the wound. Gangrene rarely follows ligation of the main artery to a limb if the ligature is aseptic and placed in a healthy part of the vessel. The compression of the tissues by a hæmatoma adds greatly to the risk of gangrene. Thrombosis of the collateral vessels proximal to the wound in the artery is also an important factor in the causation of gangrene after ligation. Vascular suture is seldom feasible, but should always be attempted in wounds of vessels such as the popliteal, common femoral, and the lower third of the axillary artery. The conditions necessary for successful repair by suture are (1) asepsis in the wound, (2) healthy arterial coats, and especially an unruptured internal coat.

The patients with small superficial wounds may present symptoms of diffuse hæmatoma or of internal hæmorrhage, which may closely resemble and be mistaken for shock. Rhythmic expansion is sometimes noted in a diffuse hæmatoma, and an intermittent blowing sound synchronous with the pulse may be heard on auscultation: these signs, however, may be absent.

When a large artery has been wounded, the patient complains of severe pain, which is not increased by pressure, and the limb is usually completely immobilised by muscular contractures. Such cases are also associated with a certain degree of shock.

Cases in which the hæmorrhage has led to a diffuse hæmatoma should be operated upon at once in order to limit the grave risk of

subsequent gangrene due to ischæmia or infection. The author advises immediate operation, even when the wound in the soft parts is punctiform, in order to prevent infection and secondary hæmorrhage, and also because it is easier and less dangerous to operate early than after the formation of an aneurysmal sac.

Preventive hæmostasis is of capital importance when operating on cases with a large hæmatoma; for this purpose it is preferable to expose the artery by incision above the level of the wound. The use of a rubber tourniquet or compression of the artery by digital pressure is not recommended. A strong piece of catgut is passed under the artery without tying, as the angulation of the vessel, by drawing on the ligature, is sufficient to arrest the current of blood.

For opening the hæmatoma large incisions are advised, as good exposure is necessary in order to ligate the bleeding point.

The author has operated on forty-two cases of wound of a large artery with diffuse hæmatoma, and observed that simultaneous ligation of the vein does not increase the danger of gangrene. In five cases of hæmatoma of the axillary region there was one death and two cases of gangrene of the hand and forearm. Two deaths and two cases of gangrene occurred in a series of nine cases of hæmatoma of the thigh. Gangrene of the foot followed operation in two of a series of five cases of hæmatoma of the popliteal region.

Alamartine (*ibid.*) has operated on thirty-two cases of serious vascular injuries without external hæmorrhage. Traumatic aneurysm was present in six of the cases, in five there was a communication between the main artery and vein, and in twenty-one cases there was a diffuse hæmatoma, due either to a wound of the artery, or of both artery and vein. Thirty of the patients recovered, but secondary amputation was necessary in three of the cases. The author insists upon the advantage of early intervention before the formation of an aneurysmal sac, and on the necessity of ligating the actual bleeding points rather than controlling the hæmorrhage by ligation of the vessel at a distance.

Gregoire and Mondor (*ibid.*) discuss their results in a series of seventy-four cases of vascular wounds. Only eleven of the cases were bleeding when brought to the field hospital, and in twenty-three cases there was no immediate sign of hæmorrhage. Spontaneous arrest of hæmorrhage may be due to lodgment of the projectile in the artery or to curling of the inner coat of the vessel, or in some cases to the formation of a clot. Although in certain cases recovery follows without subsequent hæmorrhage, such a fortunate result cannot be anticipated. Secondary hæmorrhage is very likely to ensue if sepsis develops in the wound, but there is also a risk of bleeding in aseptic cases from dislodgment of the clots. It is advisable, therefore, to operate in every case in which a wound of an important vessel is suspected.

The authors observe that, in the early stages of cases of extravasation of blood or of hæmatoma due to a perforating wound of a vessel, the swelling rarely shows pulsation, although later aneurysmal signs are likely to develop. When a large vessel is ligated, the authors recommend, as a general rule, the ligation of the vessel immediately above and below the bleeding point. Distal ligation is not so satisfactory, and is only to be employed when the wound segment of the artery is deprived of its sheath over a considerable area. Six deaths followed operation in the series of cases. In six cases gangrene due to ischæmia developed and amputation was necessary.

Peri-arterial Sympathectomy.

Leriche and Heitz (*Lyon chirurgical*, July to August 1917) record eighteen cases of reflex nervous affections following gunshot injury which were treated by resection of the sympathetic nerve fibres, which form a fine plexus in the sheath of the main arteries. The symptoms which called for treatment were mainly paresis and contracture of muscles associated with circulatory disturbance in the limb, the parts affected being cold, cyanosed, and sometimes œdematous. Babinski, Froment, and Heitz have studied the alterations in the local circulation accompanying paralysis and contracture of the muscles, which are mainly reflex in origin, and have found that the circulatory changes are due to vaso-constriction. It is probable that the vaso-constriction seen in some cases after wounds of the peripheral parts is due to involvement of sensory motor nerve fibres in the deeper parts of scar tissue; the grey matter of the cord is irritated by afferent stimuli, and reflex stimulation of the sympathetic cord with consequent vaso-constriction follows. As it is impossible to remove all the scar tissue, as would be the ideal treatment, the authors proposed to modify the circulatory phenomena, by interfering with the fine sympathetic plexus in relation to the coat of the main artery supplying the affected part. Cases were therefore chosen in which the vasomotor symptoms were particularly well marked.

The operation is performed by carefully dissecting and removing the cellular sheath of the artery together with the sympathetic vasomotor nerves for a distance of 10 to 12 cm. at least. When the hand is involved, the brachial is selected; if the foot is affected the sheath is dissected off a segment of the femoral artery. In five of the cases the main artery was found to be thrombosed as the result of the injury, and the occluded segment of the vessel, together with its sheath and sympathetic plexus, was removed.

The following results were observed:—

1. The operation is followed, after a short period of arterial constriction during the manipulations of the vessel, by an elevation of the blood-pressure in the limb beyond.

2. It is always followed, after the period of arterial constriction, by an intensive vaso-dilatation, which lasts for several weeks and causes a considerable increase in the temperature of the limb.

3. The reaction which follows resection of an obliterated segment of an artery is similar, but rather more intense and prolonged than after simple excision of the sheath of the artery.

4. Both operations have a striking influence on the voluntary contraction of muscles, the motor power of which was previously abolished.

The improvement observed in these cases is to be attributed to vaso-dilatation and the consequent improvement in the nutrition of the muscles, skin, and other tissues. The disappearance of the reflex phenomena—contractures, coldness, cyanosis, œdema, etc.—is not always definite at once, and it may be advisable to aid the effect of the vaso-dilatation obtained by sympathectomy by hot baths of paraffin and by proper exercises and massage. None of the patients were rendered worse by the operation and almost all of them were improved. When the vasomotor symptoms are slight, and the electrical reactions of the muscles are little altered, the authors recommend that treatment should be confined to simpler measures. In many cases there is a functional element which can be best treated by suggestion, isolation, etc. The operation of sympathectomy should therefore be limited to severe cases when simpler methods of treatment have failed.

J. M. G.

OBSTETRICS AND GYNECOLOGY

UNDER THE CHARGE OF

A. H. F. BARBOUR, M.D., AND J. W. BALLANTYNE, M.D.

Chorea Gravidarum.

Chorea gravidarum is a sufficiently rare complication of pregnancy to warrant the publication of all cases occurring under the care of scientific and reliable observers; but Dr. Silvio Flamma (*Ann. di ostet. e ginec.*, 1917, ann. xix. pp. 69-86) is able in addition to record a novel form of treatment in the instance of this malady which he reports. The patient who was the subject of chorea gravidarum was a primipara, 21 years of age, who entered the Maternity Hospital of Arezzo in December 1915. Her relatives were free from diseases of the nervous system; but she herself had suffered from nephritis at the age of 12 and again when 17 years old. She had been married for two years and was pregnant at the third month. She complained of continuous involuntary and disorderly movements of the head, the trunk, and the limbs. She was treated by purgatives, enemata, and sedatives for some days, but since the condition became worse and she was losing weight the induction of abortion was practised. The puerperium was normal, and by the

tenth day the choreic movements had ceased save in the fingers. She left the hospital in a good state of health. She returned in July 1916, stating that she was again pregnant, that she was suffering once more from choreic movements, more particularly of the fingers and lips, and that she wished to have the induction of abortion again procured upon her. She was found to be two months pregnant, and she was treated by purgation and by bromides in very large doses, but without any improvement being registered; in fact the movements became worse, and she loudly demanded the induction of abortion. It was therefore decided to simulate the procedure. She was put under chloroform, the skin of the external genitals was wounded, and with the blood coming from it some gauze was stained and then placed in the vaginal canal. On the following day the blood-stained gauze was withdrawn from the vagina and was shown to the patient, who was convinced that the womb had been emptied. The movements disappeared steadily, and eight days later she left the hospital in good health. She continued in good health, although she was somewhat surprised by the continued absence of the menstruation and by a slight increase in the size of the abdomen. The feeling of quickening was attributed by her to intestinal disturbance. Finally, at the seventh month, she was told fully by her husband what had been done. She was satisfied with the existing state of matters, as she was free from all suffering; and at the full term she gave birth spontaneously to a healthy living male child, and made a good recovery. Dr. Flamma further reports a case of vomiting in pregnancy which had recurred in three consecutive gestations requiring induction in each instance; in the fourth the operation was simulated, and the patient continued her pregnancy with good health. For the purely nervous type both of chorea gravidarum and of hyperemesis this method of treatment by suggestion may fairly be tried, but it is doubtful whether success can be looked for in the toxæmic varieties, and obviously one must be careful not to lose valuable time and so prevent the use of induction in the cases which really require it. Nevertheless Dr. Flamma's plan is well worth attempting, for one is glad of any means to diminish the inevitable loss of fœtal life which the induction of abortion necessarily entails.

Endocrine Organs and Reproduction.

A great literature has recently grown up around the subject of the relation of the organs with an internal secretion to the processes of reproduction, and a striking series of sixteen articles is printed in the September part of *Surgery, Gynecology, and Obstetrics* (1917, vol. xxv. pp. 225-360) bearing upon almost every aspect of the problem.

Dr. Emil Goetsch, for instance, deals with the relation of the *pituitary gland* to the female generative organs from the experimental and clinical aspects; and he reaches the following conclusions:—(1) There

is a close interrelationship in function between the pituitary and sex glands; (2) overfunction of the pituitary anterior lobe is associated with overactivity of the sex glands; (3) deficiency of pituitary secretion in the individual is followed by under-development and genital aplasia in the young and by sexual inactivity and retrogression in the adult; (4) primary alterations in the function of the sex glands, as in pregnancy and after castration, are followed by pituitary hypertrophy and hyperplasia; (5) the specific action of posterior lobe extract ("pituitrin") upon the smooth musculature of the uterus and bowel has led to the wide usage of this drug in obstetrical practice and in the treatment of intestinal paresis following abdominal and pelvic operations; and (6) the administration of pituitary extracts is of distinct benefit in clinical states of pituitary under-function, and cases are referred to in which irregular menstruation, amenorrhœa, and sterility dependent upon primary pituitary disease were benefited to such an extent that menstruation and the libido returned after having been absent for a considerable period.

Dr. Carl Voegtlin (pp. 244-250) considers the physiological and pathological importance of the *parathyroid gland* from the *experimental* aspect. He concludes (1) that the parathyroid gland has a definite physiological function which is at present incompletely understood; (2) that the presence of a minimum of parathyroid tissue in the body is essential for life and for the continuation of normal metabolism; (3) that parathyroid insufficiency seems to be characterised by an increased irritability of the nervous system to the galvanic current, which may be due to the withdrawal of soluble calcium salts from the blood and tissues, and that parathyroid insufficiency leads to an alkalosis, which is converted into an acidosis as a result of active tetany; (4) that pregnancy puts an extra strain on the functions of the parathyroid, as evidenced by the appearance of tetany during this period in partially parathyroidectomised animals; (5) that tetany has been observed during lactation in animals with parathyroid insufficiency, and that interruption of lactation was followed by recovery; (6) that the offspring of partially parathyroidectomised animals exhibit a marked increase in nerve irritability; (7) that an intravenous injection of soluble calcium or strontium salts or hydrochloric acid almost instantly removes the symptoms of tetany, and that the spontaneous recovery from tetany in experimental animals is probably due to changes in their metabolism (acidosis) caused by the hyperactivity of the skeletal muscles during tetany; (8) that the experimental facts do not support the theory that eclampsia is due to hypoparathyroidism; and (9) that a condition which might justly be termed hyperparathyroidism is unknown at the present time.

Dr. Eugene Pool and Dr. F. Robbins (pp. 260-271) have prepared a review of the relation of the *parathyroid system* to the female genital apparatus from the *clinical* standpoint. They conclude that although

no direct relationship has been established between the parathyroids and the female sex organs, and although no morphological changes in the parathyroids have been noted during pregnancy, yet there is apparently a connection between the parathyroids and the *sex processes* in the female. Tetany, which is the clinical evidence of insufficient parathyroid function, is somewhat prone to occur in menstruating, pregnant, and puerperal women, as well as patients suffering from gynecological diseases or who have undergone gynecological operations The cause of maternal tetany is now referred to parathyroid insufficiency, and the function of the parathyroids is apparently closely connected with calcium. There is reason to believe that maternal tetany and lactation tetany are associated with calcium deficiency. Latent tetany or a subtetanic condition is much more common in pregnant and puerperal women than is usually assumed. Tetany in new-born infants, the offspring of tetanic mothers, is usually fatal within a short time after birth. Finally, in the treatment of maternal tetany, the administration of calcium in large doses is followed by beneficial results in the great majority of cases.

Dr. Carey Pratt M'Cord (pp. 250-260) has the difficult subject of the *pineal gland* committed to his care, especially in regard to its influence upon antenatal development. He admits that conclusions on this subject must be flexible rather than dogmatic, but he thinks that it may be credited that the pineal gland is an organ of internal secretion, with functions, however, which are of minor significance in the general activities of the endocrinous system. A clinical syndrome is to be associated with disturbance of the pineal functions; but because of the involution of the gland at puberty, the constitutional manifestations of its pathology appear to be confined to prepuberal years. The essential characteristics (apart from pressure and neighbourhood manifestations) are (*a*) early sexual development, evidenced in the enlarged genitalia, pubic hair, general body hair, and early change in voice; (*b*) precocious mental development, manifested in maturity of thought and speech; and (*c*) general overgrowth of the body, to the extent that a child of 6 or 7 years may have the appearance of a child near puberty. The experimental extirpation of the pineal gland is surgically possible; the organ is not essential for the maintenance of life. The early symptoms following pinealectomy are to be ascribed to the severe brain injury. No changes seem to follow its removal in the adult, but in young animals it has been stated that precocity of development ensues. The administration of pineal substance to young mammals has been found to hasten growth and sexual maturity. In unicellular organisms (paramœcia) pineal extracts, according to M'Cord's experiments, increase the rate of reproduction to more than double that of controls; in larval forms of ranidæ, which in many respects correspond to embryonic and intra-uterine life in higher animals, both growth and differentiation are

hastened as a result of pineal feeding. Further experiments upon the pineal gland would seem to be necessary before therapeutic attempts can be made.

Regarding the *thyroid gland* (pp. 272-275), Dr. David Marine writes that there is evidence in man of a thyroid sex gland interrelation recognisable in the female in association with the development of secondary sexual characters, with menstruation, and with pregnancy, and also in the male at puberty, but to a very slight degree. Dr. Alwin M. Pappenheimer (pp. 276-283), in considering the *thymus gland*, has to admit that the large amount of research and the huge literature on the subject do not lead to very definite conclusions. He is of opinion that the loss of the thymus in young animals is not of prime importance, and is readily compensated for in ways which are not yet understood. Fulci reports that pregnancy in rabbits accelerates the regression of the thymus, but that after the birth of the young there takes place a distinct renewal of growth. Dr. Pappenheimer, however, is doubtless right in stating that the facts concerning the thymus do not lend themselves as yet to clinical application.

Dr. A. J. Carlson (pp. 283-293) gives a most interesting summary of what is known of the endocrine function of the *pancreas*. In relation to reproduction, he concludes that there is at present no evidence of any specific relations of the endocrine functions of the pancreas to the gonads, male or female, or to pregnancy, menstruation, or lactation. Absolute diabetes, induced after conception, leads to death of the fœtus, and it probably renders conception impossible. Partial diabetes, under careful dietary control, permits of normal sex life of women, and pregnancy under such conditions does not aggravate the diabetes; but in the absence of such dietary control the condition of pregnancy aggravates the diabetes in the mother, and uncontrolled diabetes in the mother is extremely injurious to the fœtus. There is some evidence that in late stages of pregnancy the fœtal pancreas may function for the mother.

Dr. Swale Vincent (pp. 294-299) summarises what is known of the influence of the *adrenal bodies* upon the genital system, and after emphasising the importance of distinguishing the two anatomically and physiologically independent parts of the suprarenal gland he states that the cortex has important functions in connection with the development and growth of the sex organs. Tumours of the cortex are frequently associated with sex abnormalities. When they develop in the female an accentuation of male secondary sexual characteristics develops and simultaneously a hypoplastic condition of the internal generative organs supervenes. Further, the cortex enlarges during breeding and pregnancy, and feeding young animals with adrenal gland substance seems to stimulate the growth of the testes. In his article on the *ovary, uterus, and mammary gland*, Dr. Leo Loeb (pp. 300-

315) deals most illuminatingly with the cyclical changes which occur in these three organs, and states that the corpus luteum subserves at least two functions—inhibiting ovulation and producing a substance which causes growth in the uterus. The ovary itself has other non-cyclical functions, viz. a trophic influence on the genitals and the determination of the development of the secondary sexual characters and of the mammary gland. Dr. William P. Graves considers (pp. 315-323) the transplantation and retention of *ovarian tissue* after hysterectomy, maintaining that the retention of such tissue is of little or no physiological value under these circumstances, and may even be productive of serious harm. Dr. W. H. Morley (pp. 324-328) pleads for the more uniform preparation of *placental and ovarian extracts;* and Dr. Robert T. Frank (pp. 329-331) discusses the *placenta* as a gland of internal secretion, believing that corpus luteum and placental substance are apparently identical, but leaving it in doubt whether the placenta acts merely as a storage reservoir for corpus luteum secretion during the latter half of pregnancy or elaborates a hormone of its own. Drs. Murlin, Bailey, Martin, and Holmes Jackson (pp. 332-360) deal with yet other aspects of this most complicated problem of the relations of the endocrine organs to reproduction, and bring to a conclusion one of the most valuable pieces of conjoined ("teamwork") research which has yet been carried out in medicine. J. W. B.

NEW BOOKS.

The Thyroid Gland in Health and Disease. By ROBERT M'GARRISON, M.D., D.Sc., F.R.C.P.(Lond.). Pp. ix. + 286. With 82 Illustrations. London: Baillière, Tindall & Cox. 1917.

THE purpose of this most excellent volume is to present to the reader a connected account of the functions of the thyroid and parathyroid glands and of the disorders to which these structures are liable. The book is in reality designed to embody the results of years of careful and painstaking study—experimental, pathological, and clinical—into the whole subject. As was natural in an officer of the Indian Medical Service, the author's attention was at first directed to the epidemiological side of the problem, with the result that certain facts emerged suggesting strongly that the origin of many thyroid disorders was toxic in its nature. His further investigations lead him to the conclusion that the toxins which so act are of gastro-intestinal origin.

One of the most interesting chapters in a wholly interesting book is that dealing with the effects of intestinal toxæmia in the production of thyroid lesions. These act, the author holds, (1) by interfering with the normal synthesis of the thyroid secretion, and (2) by producing a condition of chronic toxic inflammation in the gland. These con-

clusions are supported (in Appendix II.) by the detailed results of treatment in fifty-seven cases of goitre by means of intestinal antiseptics.

In the latter half of the book excellent descriptions are given of the various disorders of the thyroid and parathyroid glands. The sections which deal with treatment are specially noteworthy, but indeed the whole book is one which ought to be read carefully by all who are interested in the clinical and pathological aspects of endocrine disease.

A Handbook of Practical Treatment. Edited by T. H. Musser and T. C. Kelly. Vol. IV. Pp. 1000. Philadelphia and London: W. B. Saunders Co.

The treatment of disease is essentially progressive, and published volumes are soon out of date. This volume of practical treatment takes the place of one published a year or two ago, and brings up to date articles on various subjects which recent investigations have rendered incomplete. It is a compilation by numerous authors—each a specialist in his own subject—all of them American, with the exception of Sir Clifford Allbutt and the late Sir Lauder Brunton. Various surgeons have also contributed in those conditions which, usually medical, often necessitate surgical interference. The editors on the covering call the volume "The newest treatment," and the contents readily bear this out.

One finds in the volume, for example, the latest results of splenectomy in pernicious anæmia; a full description of specific therapy in pneumonia, with the results obtained by the use of operation and serum therapy; an excellent chapter on recent treatment of typhoid and syphilis, and the latest records of the treatment of the various degrees of intestinal stasis. The various diseases are discussed under their particular system, there is no overlapping, and methods of treatment are simply described and readily understood. Symptomatology and diagnosis are but briefly touched upon, and the attention is not overburdened with discussions on treatments which have had their day but are no longer efficacious. This volume will undoubtedly form an important work of reference for practitioners who desire to keep themselves abreast of the newest methods of treatment of disease.

The Indian Operation of Couching for Cataract. By Lieut.-Col. R. H. Elliot, I.M.S. (Retired), M.D., F.R.C.S. Pp. xii. + 94. Illustrated. Price 7s. net.

This interesting monograph will be appreciated by ophthalmic surgeons, and especially by officers of the Indian Medical Service. The history of couching, the technique of the operation, and the habits of the Indian coucher are discussed in the first three chapters. The difference between couching and reclination is pointed out, and the author throws an interesting light upon the psychology of the coucher and of his

patients. The fourth chapter gives the results of an analysis of 780 cases. It would appear that only about 20 per cent. of the native results can be considered to be comparatively successful, and it is noteworthy that Punjabi couchers are more successful than their Mahomedan confrères of the south. The pathological anatomy of couched eyes, as contained in the Hunterian Lectures for 1917, forms the subject of the fifth and longest section of the work. It is illustrated by six plates of excellent photographs, both of macroscopic and of microscopic specimens. Chapter VI. deals with diagnosis. The problems are, firstly, to ascertain whether the operation of couching has been performed; secondly, the position of the lens and its condition; and, lastly, to decide whether further interference is advisable. Extraction of the lens is most strongly indicated in those cases in which the lens is dislocated but mobile, and obstructs vision by falling across the pupil: In this connection the author emphasises the necessity of avoiding damage to the reputation of Western surgery by too freely undertaking operative measures which are fraught with considerable risk, as interference with a dislocated lens so often is. A final short clinical chapter deals with the pain following couching, both immediately and later, and with some of the rarer accidents which may occur.

The work is interestingly written, well illustrated, and the print and paper are pleasant to the eye. A useful index and bibliography are provided.

Experimental Pharmacology. By DENNIS E. JACKSON, Ph.D., M.D., Associate Professor of Pharmacology, Washington University Medical School, St. Louis. Pp. 536. With 414 Illustrations. London: Henry Kimpton. 1917. Price 20s. net.

THE author of this book, intended for medical students, remarks that the subject is for them but poorly developed, though one of the most valuable and interesting of all medical subjects. He has greatly assisted in the development of the subject by the publication of this book, and it should find its place in the library of every teacher of pharmacology. He describes and illustrates the laboratory arrangements, tools, appliances, and apparatus which have been found of most utility, and describes and illustrates, with marked success, the various stages in the surgical operations necessary for each experiment.

So far as the experimental side of the subject is concerned, we have nothing but praise for the manner in which the subject is presented. With regard to the pharmacology, there must be obviously made a rigorous selection from the 168 experiments, some of which last three or four hours, and we think that the practice of administering several substances in succession in one experiment open to grave objection on the ground of confusion of action and difficulty of analysis. We also think that the question of dosage, which in pharmacology is all-important, does not receive enough consideration and comparison with

therapeutic quantities. Thus in experiment 18 there is no indication that the dose employed is large, and that if ten drops of the solution were applied to the heart that it would be equivalent to something like three ounces of chloral hydrate applied to the human heart, and that this has little bearing on effects produced with medicinal doses.

Where such care and elaboration of experimental method is shown in many experiments it is surprising to find so primitive and inaccurate a method of perfusing the blood-vessels of the frog with no attempt to keep the perfusing fluid under constant pressure.

The merits of the book largely outweigh its imperfections, and if students in this country had the time to perform some of these experiments they would no doubt have a more definite knowledge of pharmacology than many of them now possess.

The Practitioner's Pocket Pharmacology and Formulary. By L. Freyberger, M.D., M.R.C.P. Pp. 545. London: William Heinemann. 1917. Price 12s. 6d. net.

This is an elegant volume of handy size, and stated to be a compilation of the official remedies of Great Britain and the U.S.A., with some non-official remedies of tried and established value. It is not easy to understand why the volume has been written, for a great deal of labour must have been spent in what is really a recapitulation of the B.P. and U.S.A. remedies. It does not supply a tithe of the information so well presented in Martindale and Westcott's book, nor does it pretend to be an exhaustive reference work to all the drugs in all the pharmacopœias, such as has been so well done by Ewald and Heffter in their *Handbuch der Arzneiverordnungslehre.* The book may be found useful to the busy man who wishes to look up a remedy or to find some suitable drug for a change of treatment, but the information supplied is not exhaustive by any means.

Lessons in Pharmaceutical Latin and Prescription Writing and Interpretation. By Hugh Muldoon, Ph.G. Pp. vii. + 173. New York: John Wiley & Sons. London: Chapman & Hall. 1916. Price 6s. net

This little book is intended for the instruction of the pharmacist in the Latin of prescription writing, and in the twenty-five lessons into which it is divided covers the ground very completely. It is, of course, curious to teach a language with reference to only one use of it, but it does not seem to us clearer to explain the genitive case as a limiting case, instead of the case of the genus or kind. We are not aware of the substantive "semis" being used as an adjective, and if there is such a use, it is unnecessarily confusing, and need not be mentioned. O.K. and Q.R. (quantum rectum) are scholastic jests rather than legitimate abbreviations, but these are minor defects in a little book very complete for its purpose.

EDINBURGH
MEDICAL JOURNAL.

EDITORIAL NOTES.

The late Charles Templeman, M.D., D.Sc., M.O.H., Dundee.

Dr. Charles Templeman died early on the morning of Sunday, 20th January. He had been acutely ill for a week. There was a hope that the urgency of his illness had passed—he was, indeed, bravely preparing for duty again, laughingly asserting his fitness and showing objective signs of partial recovery, when he once more developed grave symptoms, became suddenly unconscious, and in a few hours died.

For his many warm friends it wrings the heart to write, "Thou'lt come no more." For here was a man full of loving-kindness, who, out of a nature richly endowed with feeling, carried with him in all his work, for a lifetime, an atmosphere of humanism and personal joy in "doing good." In the city of his professional and official labours he will be missed as the sunlight is missed when a beautiful day ends. I have known many officers whose personal character and work I have admired and rejoiced in, but I have known none to shed a warmer radiance of joy over the many drab and squalid realities of life. He gathered friends wherever he went, and his many fine achievements as Medical Officer of Health in Dundee flowed from him simply and naturally as the gift of a fine social intelligence, inspired by a warm heart.

How he was appreciated by his immediate community may be seen from the sympathetic sketch published in the *Dundee Advertiser* of 21st January.

I have known Dr. Templeman for over twenty-five years, and I am familiar with every phase of his work through that period. It is only those of us that have fought side by side with him that can place a value on what he did. What always impressed me about him was his readiness to take up new lines of work. He never grew stale. I have watched him teach; he lectured with ease and grace. He could adapt his exposition to his audience. It was no effort for him to teach one day the students in training at the Provincial Training College, another day his medical students at University College, the next day

a popular audience or a committee of the Town Council. When Miss Walker and Miss Mona Wilson conducted their admirable inquiry into the social aspects of Dundee school children, they found in Dr. Templeman a cordial coadjutor and a skilled director. How far-reaching his social work as a Medical Officer of Health was can be seen from the many new and good studies published in his annual reports. Of the many thousands of official reports that it has been my business to scrutinise, few gave me more pleasure than Dr. Templeman's. I could always count on his "breaking out in a new place." I have spent days with him in his administrative work, and, if space allowed, I could give fascinating accounts of what he did, both as Police Surgeon and as Medical Officer of Health, for children, tuberculosis, hospitals, sanatoria, venereal diseases, and other sections of Public Health service.

He was happy in the moment of his death, for he was occupied with a new lecture when the warning came, and his last conscious hours were filled with the greater things yet to be done. He fell fighting, but he has left a generation grateful for his service, and in the history of the Scottish Health Service he will live by the concrete record of his many fruitful ideas and actions.

W. Leslie Mackenzie.

CASUALTIES.

Died on service, on 15th January, Brigadier-General Arthur Anthony Howell, C.M.G.

General Howell took the Diploma of L.R.C.P.(Edinburgh) in 1891.

Died of wounds caused by a bomb on 27th December 1917, Colonel Charles Christie Fleming, D.S.O., R.A.M.C.

Colonel Fleming graduated M.B., C.M. at Edinburgh University in 1888, and after filling various resident hospital appointments in the Edinburgh Royal Infirmary and Sick Children's Hospital entered the R.A.M.C. He saw active service in Egypt and in South Africa. At the time of his death he was acting as A.D.M.S. to the Highland Division.

Died of wounds, Captain Norman M'Gaan Smith, R.A.M.C.

Captain Smith graduated M.B., Ch.B. at Glasgow University in 1915.

Died on service, on 21st December 1917, Captain Wilfred Ernest Gibbons, R.A.M.C.

Captain Gibbons, who was in practice in Leicester, graduated M.B., C.M. at Edinburgh University in 1896, and M.D. in 1900.

ACCIDENTALLY killed, Captain HERBERT MATHER SPOOR, M.C., R.A.M.C.

Captain Spoor was Superintendent of the Hoo Isolation Hospital, and was a graduate of Edinburgh University—M.B., Ch.B., 1908.

DIED on service, Captain ALEC ROBB-SMITH, R.A.M.C.

Captain Smith graduated M.B., C.M. in the University of Glasgow in 1892, and after filling various hospital appointments, settled at Chiselhurst, Kent.

DIED on service, Captain ROBERT WISEMAN CUNNINGHAM, Australian Army Medical Corps.

Captain Cunningham graduated M.B. and Ch.B. at Glasgow University in 1916.

DIED on service, Captain SYDNEY HERBERT MORRIS, R.A.M.C.

Captain Morris graduated M.B. and Ch.B. at Edinburgh University in 1899.

STUDENTS OF MEDICINE.

KILLED on service, ROBERT CAMERON, Lieutenant, R.F.C., a student in the University of Glasgow.

DIED in Mesopotamia on 4th January, DOUGLAS A. SPROTT, Lieutenant, Border Regiment, a student in the University of Edinburgh.

Honours.

The honour of Knighthood has been conferred on Lieutenant-Colonel Harold Jalland Stiles.

Triple Qualification Passes.

AT the examinations of the Board of the Royal College of Physicians of Edinburgh, Royal College of Surgeons of Edinburgh, and Royal Faculty of Physicians and Surgeons of Glasgow, held at Edinburgh in January, the following candidate passed the *First Examination*:—John Matthew.

The following candidates passed the *Second Examination*:—Agnes M. Hill, John B. O'Neill, Aubrey C. F. Barrow, Gracie O. D. Evans, Janet A. A. Sang, James MacGlashan, Henry A. Newton, John R. M'Cubbing, Donald Mackay, and Ben A. Coid.

The following candidates passed the *Third Examination*:—Jane Copes, Iain R. Macphail, Reginald J. Patchett, Daniel A. Stegman, Jatindra K. Sen, and Leo H. Peries.

The following candidates, having passed the *Final Examination*, were admitted L.R.C.P.E., L.R.C.S.E., L.R.F.P.&S.G.: — William O'Gorman Donoghue, Glasgow; Christopher Robert Cecil Moon, Derby; and Arukatti Patabendigo Frederick Abeysuriya, Ceylon.

JOHN HUNTER'S FREE MARTIN: WITH REMARKS ON SOME RECENT INVESTIGATIONS.

By D. BERRY HART, M.D., F.R.C.P.E.,
Lecturer on Midwifery and Diseases of Women, Surgeons' Hall, Edinburgh.

I WISH in the present communication to raise once more and briefly the question of John Hunter's free martin. I do so not only from a wish to bring forward additional facts ascertained in my recent work on male and female pseudo-hermaphroditism, but also to consider the lately published papers on the free martin by Lillie, Chapin, and Newman. I shall first take up (*a*) the anatomy of the genital tract in the free martin; (*b*) the genital tract in the bull and in man when derived from a single zygote; (*c*) the mechanism of the production of Hunter's free martin. I shall then consider the views of the three investigators already mentioned. The somatic changes in the free martin will not be considered, as I have already described them, and they are easily recognised and well known.

(a) *The Anatomy of the Genital Tract in the Free Martin.*—The peculiarities in it are remarkable, and may be summed up as follows (see Plate I.):—

The sex of Hunter's free martin is male in my opinion, as a defective testis and Wolffian duct are present. John Hunter considered the free martin as male, *i.e.* that it had the same sex-gland, although defective, as the normal co-twin bull. In one case he was not so certain. Spiegelberg of Breslau (in 1861) was the first to demonstrate that the defective sex-gland in the free martin was testicular—I owe this reference to Thomson and Geddes. On ascertaining this I asked Dr. Arthur Keith, of the Hunterian Museum, London, to examine Hunter's preparations, and I owe to his kindness the fact that the sex-gland in a typical one was male, testicular tissue and epididymis being present. I have published micro-photographs of these (*Proc. Roy. Soc. Edin.*, xxx. pt. iii. No. 10). This condition of the sex-gland is not peculiar to the free martin, but is also found in undescended testis cases and in human male pseudo-hermaphrodites. It is thus not a key to the free martin's peculiarities.

There is thus identity of sex between the free martin and its normal and perfect co-twin, a bull.

Sex in the male has only one criterion, the existence of a sex-gland containing sperm cells. One cannot ascertain the sex from

PLATE I.

Genital Organs in calf Free Martin (Spiegelberg) ½. *a*, Urinogenital sinus (inverted) laid open and turned back. A sound is passed into the Mullerian non-potent element, with the knob ending at *c*, the uterus; *dd*, Vesiculæ seminales; *cef*, Vasa deferentia; *gg*, imperfect testes; *hh*, Wolffian bodies.

the sex-duct or external genital systems. The free martin and its co-twin are not identical twins, as they differ in their genital tract. We get twins in cattle and humans which are identical both in body and genital tract, and in the human cases they may be indistinguishable. This identity extends even to their palmar impressions.

The reason of the identity of sex in cattle twins is due to the fact that they are derived from one zygote, *i.e.* a male zygote in cattle which may produce a single bull may also produce twins, one a perfect bull, the other a free martin. How does this happen? When a single zygote produces a single bull, one of the earliest things to happen is that a part is set aside, the primitive germ-cell mass, to form the future sperm-cells, the rest of the zygote giving rise to the "soma" or body of the animal. As the somatic part develops for the individual, the germ layers are being formed; these primitive germ- or sperm-cells travel through them, and ultimately reach the genital ridges on the Wolffian bodies, where they form the sperm- or germ-cells according to whether the zygote has been male or female. This was first shown by Owen, then by Eigenmann, specially by Beard, and confirmed by observers at home and in America too numerous to mention, Woods, Rubaschkin, Jenkinson, Keith being the chief observers or adherents. Waldeyer of Berlin, a most eminent observer, unfortunately went astray, and in the ovary of the chick derived the future oocytes from the somatic epithelium covering the ovary. These cells are somatic, and cannot by mitoses give rise to oocytes. Waldeyer's view has exerted a most unfortunate influence on embryology. The reason was that he only sectioned the chick early ovary, not the rest of the specimen. When, however, early fish embryos were sectioned in their entirety, the germ-cells could be traced in the layers and found ultimately in the genital ridge. Thus the future germ-cells are a product of an early zygotic condition, and must be either germ- or sperm-cells. When, however, a single male zygote twins, it doubles its germ-plasma and probably its p.g.c. mass either before or after division, and thus the identity of sex.

The doubling is followed by segregation of two masses, somatic and p.g.c. This may be equal, and thus twins may arise identical in p.g.c. mass and body.

This segregation may be unequal, however, and thus the free martin arises. How its genital tract is imperfect can only be traced after some other facts are considered.

The epididymes and Wolffian ducts are present in a rudimentary form, and the vesiculæ seminales are represented.

The testes are undescended in the free martin, and this is due probably to defective development of the Wolffian bodies and gubernaculum (see Plate I.).

The Müllerian ducts are present in a very elementary condition (Plate I.).

This is well seen in Spiegelberg's plate, and is the representative of the hydatid testis found in the single bull.

There is a urinogenital sinus as well as labia majora and clitoris.

In my previous papers I did not explain this last fact, but a recent investigation into pseudo-hermaphroditism in the human male and female enables me to do so now. The presence of the urinogenital sinus and labia in the free martin is *due to an inversion of female structures*, and is clearly seen in single male human pseudo-hermaphrodites. These have often, although not always, a urinogenital sinus, labia majora, and clitoris, with a hymen. The normal human female vagina has its lower third derived from the urinogenital sinus, and as the hymen is derived from the lower ends of the Wolffian ducts, it appears in the human male pseudo-hermaphrodite when the sinus is present. In a similar way the rarer female pseudo-hermaphrodite has always the male prostate and prostatic sinus inverted into the genital tract, and only the upper two-thirds of the vagina are represented, the lower or sinus element of the vagina ending as a slender tube in the prostate.

To elucidate this matter more fully, we must now consider the question of

(b) *The Genital Tract in the Bull and Human Male when Derived (without Doubling) from a Single Zygote.*

Here we have sex-gland (testes descended), vasa deferentia (Wolffian ducts), and phallus, the potent organs; in addition, there are present opposite sex-duct elements, viz. the hydatid testis and prostatic utricle, the non-potent organs. These are rudimentary and at a normal minimum, the potent organs being at a maximum. It is these non-potent Müllerian relics that are derived by transference into the free martin when twinning takes place. It has not been yet shown that they are absent in the potent co-twin, but that may yet be settled by Lillie's specimens. Of course they may have been doubled and present in both twins.

(c) *The Mechanism of the Production of Hunter's Free Martin.*

This I hold briefly to be as follows:—A single male zygote is

doubled—its non-potent organs transferred to the free martin; the female urinogenital sinus, labia, and clitoris have been inverted into one of the gametes, producing the single male zygote, as I have described in a previous paper (*Edin. Med. Journ.*, 1915), and thus the condition is explained.

I now go on to consider Lillie's views.

The papers by Lillie and Chapin are of great value, as their material was abundant and well investigated. I think, however, their interpretation is open to serious criticism.

Lillie's view is that the free martin and the potent co-twin, admittedly a perfect bull, are derived from two zygotes, one a male zygote, the free martin one a female zygote. The hormones of the interstitial cells of the male twin are supposed, when chorionic fusion is present, to give an anastomosis of the circulations of the twins, and then, "as a result of the introduction of the interstitial secretion of the male, those organs in the free martin, which are present in the indifferent stage, develop towards the male condition (rete, first set sex-cords, primary albuginea), and those which develop in the normal female at sex-differentiation or later are inhibited from developing (cords of Plüger, definitive albuginea), and union of Müllerian ducts form uterus" (Chapin, *op. cit.*, p. 481)). This proceeds on the supposition that the sex-gland is indifferent at first, and becomes a testis or ovary afterwards. The origin of the p.g.c.s. mass has overthrown this theory, and established it as a part of its own zygote.

Then, further, the action of the interstitial cells is unknown, and how it acts so as to stimulate or retard metamorphosis of the indifferent sex-gland is not stated.

Cattle twins are usually monochorionic, and, according to statistics, to the extent of 53 out of 55. Lillie supposes that by fusion of the chorion when two are present a monochorionic condition is formed from duochorionic conditions. Two corpora lutea are usually present in twin cases, and Lillie holds that this shows a dizygotic origin in twins where one is a male and the other a free martin. He does not, however, figure a free martin case with two corpora lutea, and this is the whole point. It is possible that only one of the two ova shed is fertilised, and that the influence making the fertilised one a true corpus luteum had also influenced the Graafian follicle of the one not fertilised in the same direction. The single zygote divided, and thus made two similar ones. Lillie speaks of a fertile free martin and a sterile free martin—a contradiction in terms. A fertile free martin is not

a free martin at all, but a normal heifer from a separate zygote, a bull being derived from the other—a male zygote.

I now take up certain of Lillie's statements to elucidate the question further by considering them.

"In a preliminary paper (Lillie, *Science*, 1916, p. 371) the author has briefly discussed the theory of the sterility, which is the rule, subject to a few exceptions, in the female of two sexed twins of cattle. In such females, commonly known as free martins, the internal organs of reproduction are usually predominantly male in character, and the external organs are usually, at least, of the female type; there are, however, considerable variations, as will appear. The conclusion was reached that the sterile free martin is zygotically a female, modified by the sex-hormones of the male twin which circulate in both individuals during fœtal life owing to secondary fusion of the chorions and anastomosis of the fœtal circulation of the two individuals."

There is considerable confusion in the above statement. Lillie assumes that the free martin is zygotically a female. It, therefore, should have ovaries. He does not consider that sex is determined by the sex-gland, and supposes that the labia and a female urinogenital are evidence of a female organism. He forgets that in a human male pseudo-hermaphrodite with defective testes, a female urinogenital sinus, labia, and a clitoris, we have an individual who is male and has the urinogenital sinus inverted into his genital tract without any causal sex-hormones from a twin source. The secondary fusion of the chorions is not an exact term. What happens is a fusion of the chorions and amnions of a local and limited nature, with absorption of this septum. The free martin is male from its sperm-cells, and these are the expression of the continuity of the sperm-plasma which cannot be modified by a hormone. Finally, on this head, the human or mammalian pseudo-hermaphrodite has interstitial cells in its testis and these modify or are causal to the secondary sexual characters.

Lillie further states as to Spiegelberg's free martin (p. 375). "If the twins are both female or of opposite sex the organs of reproduction are, as a rule, well formed; if they are both male, it very frequently happens that one of them is an hermaphrodite" (Spiegelberg's opinion), and then goes on to say, "This conclusion was based on the examination of two pairs of different sexed twins in cattle; he made anatomical examination of the free martins (*sic*) and found one of them a normal female, but in the other the female internal organs of reproduction were mostly absent and

were replaced by rudimentary seminal vesicles, rudimentary vasa deferentia, and a rudimentary gonad on one side, which he interpreted as probably a small testis with more or less separated epididymis. The internal organs were accepted as diagnostic of sex, and the case was interpreted as simple male transverse hermaphroditism" (Lillie, pp. 375-376). Lillie's idea of a fertile free martin thus leads to confusion, and also contradicts his own definition of a free martin.

Spiegelberg's one case with a bull and fertile free martin (!) as result arose from a male zygote and a female zygote. The female was an ordinary heifer, and the two were dizygotic. On the other hand, the second case, which gave a normal bull and a free martin, was monozygotic. I suppose that, according to Lillie, the second case was dizygotic with arterial anastomoses, and thus the hormones could act. In the first case there was no such anastomosis, and the female had its genital tract unaffected. Spiegelberg's description of his one undoubted free martin as a transverse hermaphrodite is based on an erroneous interpretation, viz. that both sex-glands and sex-duct apparatus are criteria of sex—only the former is the real criterion.

Lillie (p. 376) then goes on to summarise my view, but unwittingly misstates it: "The entire argument is based on the unsupported assumption, which it is quite possible to decide definitely by the facts, that the free martin is cozygotic with its male. I shall show immediately that this is not the case; so that it is hardly necessary to point out that if the gonad of the free martin is a testis, as Hart maintains, it can hardly be classed as a non-potent part of the genital tract. . . ." I did not class it as non-potent (Figs. 1 and 2). The potent part in the bull is the sex-gland and vas deferens, the non-potent the opposite sex-duct element, the hydatid testis, and prostatic utricle. The vesiculæ seminales are present in the free martin *because it is a male.* They are present in Hunter's and in Numan's cases. Of course the sex-hormone from the potent twin has done this, but a female has no vesiculæ seminales, the Skene ducts being prostatic and defective.

I certainly did not show that the non-potent parts were absent in the twin bull, but then I had no specimens. Lillie has them in abundance in his specimens but has not examined them, and does not explain this omission.

"Finally, there is not any attempt to explain why the twinning process should be attended by such extraordinary results in cattle, and involve nothing of the kind in other mammals." I may ask

Lillie this question—" If, in cattle, hypothetical sex-hormones from the normal twin bull can make a normal heifer into a free martin, why do analogous hormones not effect the same in sheep and other mammals—why don't they cause it in the human species?"

"*Sex-Ratio of Cattle Twins*" (Lillie, p. 380).

"On this point we have observations by Cole and myself. Cole finds in a study of records of 303 multiple births in cattle that there were 43 cases male twins, 165 cases two-sexed twins (male and female), 88 cases female twins, and 7 cases of triplets.

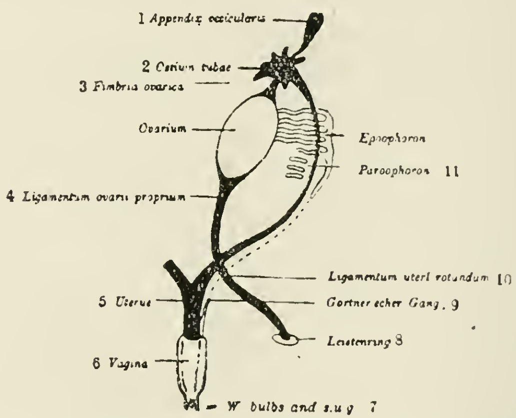

Fig. 1.—*Typical Female Sex-ensemble* (modified from Bonnet), shows (1) *Sex-gland* (ovary); (2) *Potent portion*—Tubes, uterus, vagina and external genitals; (3) *Non-potent or opposite sex-duct elements*—Epoöphoron and paroöphoron 11; secondary sex characteristics not indicated.

This gives a ratio of about 1 ♂♂ : 4 ♂♀ : 2 ♀♀ for the twins, instead of the expected ratio of 1 : 2 : 1" (Lillie, p. 380). This is the Mendelian ratio in a plant or animal crossing with one contrasted unit character on each side.

Zweifel described eclampsia as the disease of theories. Mendelism is "the great misunderstood." No subject has ever been so much muddled by all observers so far.

I began by trying to fit the potent organs (sex-gland and ducts) into the D. and R. formula. I gave this up in 1912, for the reason that it really meant nothing and led to nothing. In 1912 I said (see "Numan, the Veterinarian, etc.," *Edin. Med. Journ.*, March 1912)—" *The Theories of Dominance and Recession.* If one holds that these represent some actual significance, then the non-potent organs are to be classed as recessive, and I have

discussed this in a previous paper (*Proc. Roy. Soc. Edin.*, 1909-10). I have come to see, however, that all that the term dominant means in a unit character is that in a crossing it is expressed first in the somatic part of the zygote of F^1, while the so-called recessive quality in a crossing with two contrasted unit characters (one on each side) is distributed in a probability ratio in the propagative part of the plant or animal of F^1, and that the recessive being thus interned *quâ* F^1, in its propagative part only, appears expressed in the plant of F^2."

In the free martin, Mendelism only applies so far as the autonomy of unit characters is concerned. The hydatid testis is such

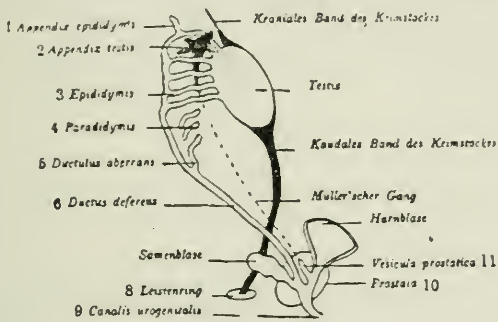

FIG. 2.—*Typical Male Sex-ensemble* (from Bonnet), shows (1) *Sex-gland* (testis); (2) *Potent portion*—Vas deferens and epididymis, gubernaculum; (3) *Non-potent or opposite sex-duct elements*—Hydatid testis, prostatic utricle 11; secondary sex characteristics not shown.

a unit character, and is transferred *en bloc* from the potent twin to the free martin.

Cole's sex-ratio is misleading. In a T-D plant crossing the qualities of tallness and dwarfness come out when summed up in several sequent generations in a 1 : 2 : 1 ratio. The segregation of the hydatid testis into the free martin takes place when the single male zygote twins, and is not a special Mendelian act in the strict sense.

Miss Chapin had a difficult task set before her. The development of the testis is not well known (see Keibel and Mall, Felix's article, pp. 881 *et seq.*). In addition to this, the hormone selected is one of which comparatively little is known (see Schäfer, *The Endocrine Organs*, p. 133). How, then, can Miss Chapin assign it so definite a *rôle* in influencing the alleged female sex-gland of the free martin? The whole work is most painstaking, but the interpretation seems to me to rest on pure hypothesis. The interstitial cells are constantly called in

by her as a *deus ex machina* to explain degenerative changes in which there is not one tittle of reasonable proof that they are effective.

I may sum up my difficulties in accepting Lillie's explanation of the free martin as follows:—

1. The fact that the single potent bull has in it opposite female sex-structures is disregarded. It is a reasonable explanation that they are transferred during the early division of the zygote into the free martin (see Figs. 1 and 2).

2. The method of studying his valuable material, viz. the *a priori* argument, is an exploded one, or at any rate one to be used with the greatest caution. Lillie takes as his theory the hormones of the interstitial cells of the testis, and as his facts the degenerated or imperfect condition of the free martin sex-glands. The latter, however, is not peculiar to the free martin, as it is found in human single pseudo-hermaphrodites and in undescended testis cases. Lillie does not account for the presence of the vesiculæ seminales in the free martin. They are present because this animal is a male.

3. The statement that a free martin may be fertile is amazing. One might as well say that a male pseudo-hermaphrodite could be fertilised.

4. The obstetric literature and views as to twins are not mentioned.

5. The consequences of the early zygotic origin of the germ-cells and its far-reaching results are omitted.

The whole material worked out is most valuable, and I hope the authors will continue to investigate it. As to the hormone theory they follow, I am certain it will lead them into further disaster. Lillie should study Geoffrey Smith's papers in the *Quar. Journ. of Micr. Science*, 1910-1914; they are against his hormone theory.

Newman accepts Lillie's hormone view. He states that my view "is evidently due, to some extent, to the preconceived idea that twins are monozygotic, and therefore should be of the same sex. It would seem unlikely that twins of opposite sex are ever derived from a single fertilised egg" (*op. cit.*, p. 100). This rests on the assumption that the free martin is a female modified by the hormones of the male co-twin—a view I have already discussed and rejected. Newman's work is interesting, but his conclusion as to the nature of the free martin I consider erroneous, and is not strengthened by accusations of precon-

ceived ideas against other observers. He states his opinions arrogantly in striking contrast to Lillie, and I therefore decline detailed consideration of his errors. The hormone theory is a wild one, and may be safely left to the corrosion of time.

References.—Chapin, "A Microscopic Study of the Reproductive System of Fœtal Free Martins," *Journ. of Experimental Zoology*, 5th July 1917. Hart, D. Berry, "On the Atypical Male and Female *Sex-Ensemble* (so-called Hermaphroditism and Pseudo-Hermaphroditism)," *Edin. Med. Journ.*, 1914, N.S. xiii. 295; "A New Route of Inquiry as to the Nature and Establishment of the Typical *Sex-Ensemble* in the Mammalia," *Edin. Med. Journ.*, 1914, N. S. xiii. 12, 101; "Numan, the Veterinarian and Comparative Anatomist of Utrecht: A Forgotten Observer on the Free Martin," *Edin. Med. Journ.*, 1912, N. S. viii. 197; "A Contribution to the Theory of Enzygotic (Monochorionic) Twins," *Edin. Med. Journ.*, 1912, N. S. vii. 297. Lillie, "The Free Martin: A Study of the Actions of Sex-Hormones in the Fœtal Life of Cattle," *Journ. of Experimental Zoology*, 5th July 1917. Newman, Horatio Hackett, *The Biology of Twins*, The University of Chicago Press, Chicago, Illinois.

CEREBRO-SPINAL FEVER.

By P. W. MACLAGAN, M.D.

II.—The Meningococcus in the Nasopharynx.

The presence of the meningococcus in the nasopharynx was first demonstrated by Councilman, Mallory, and Wright in the United States in 1898. The importance of this observation cannot be over-estimated, and, as we have seen, it is only since this date that it has been possible to understand the epidemiology of cerebro-spinal fever and its route of infection. At first only the throats of those attacked by the disease were examined, and the organism was only occasionally found. More recently, with improved technique, it has been found in as many as 93 per cent. of those attacked. During the present epidemic Dr. Scott, working in the Local Government Board Laboratories, isolated the meningococcus from the nasopharynx of sixteen out of nineteen cases examined during the acute stage of the disease. My own experience bears out this finding, if the throats are examined within a day or two of the commencement of the illness. We have also seen that a varying number of persons in the vicinity of a case harbour the meningococcus in their throats.

A certain number of these "carriers" suffer from a slight degree of coryza, and it was the occurrence of this coryza during

an epidemic of cerebro-spinal fever that first suggested the presence of the meningococcus in the upper respiratory tract. Further investigations have shown that very few meningococcal carriers suffer from coryza, but that a certain degree of naso-pharyngitis is extremely common. It may not be sufficient to attract the attention of the patient, but a swab introduced into the posterior nasopharynx will show the presence of muco-pus. Direct examination will show congested mucous membrane, and very often the presence of adenoids, in cases where the fauces and tonsils appear normal.

The habitat of the meningococcus is high up in the posterior nasopharynx. Westenhoffer has studied the pathology of this region in cases of cerebro-spinal fever. He finds marked congestion and increased secretion of the adenoid tissue of the nasopharynx, and also in some cases inflammation of the nasal mucous membrane. These changes are associated with infiltration of lymphoid tissue and of leucocytes. The fauces and tonsils are affected to a much less degree. He also found that the mucous membrane of the sphenoidal cells was sometimes congested, but that the ethmoidal cells showed little change. No one has at any time been able to demonstrate the presence of the meningococcus in either the sphenoidal or ethmoidable cells.

In connection with the confinement of the meningococcus to the posterior nasopharynx, a recent series of experiments by Lieutenant-Colonel Gordon are interesting. He finds that not only do the salivary streptococci easily overgrow the meningococcus, but that even an inconsiderable number of these streptococci exert a marked inhibitory action on its growth. This fact explains the absence of the meningococcus from the mouth and region of the fauces, and perhaps suggests a useful line of treatment in the persistent type of carriers. Another point of interest in this connection is the observation made by Dr. C. Shearer of Devonport that the presence of a small trace of nasal mucus greatly increases the growth of the meningococcus on artificial media.

The Route of Infection.

It is now generally admitted that all cases of cerebro-spinal fever become "carriers" for a longer or shorter period before they become infected by the meningococcus, and that the original seat of the organism is the posterior nasopharynx. Goeppery, struck by the frequency with which he noticed inflammation of the

Peyer's patches of the intestine, suggested that this might be the point of entrance of the organism, but it can easily be shown that the lymphoid tissue in this region is inflamed in all general infections. Therefore no conclusion can be drawn from these lesions in this disease.

The great question which we must try to elucidate is the route of infection from the posterior nasopharynx to the meninges. The close connection between the posterior nasopharynx and the meninges at the base of the brain along the filaments of the olfactory nerves at once suggest a direct spread of infection. These filaments pass from the olfactory bulbs to the posterior nasal fossa through the cribriform plate of the ethmoid bone, and they are unsheathed by prolongations from the arachnoid mater. It will be seen that the connection is very intimate. The view that this is at least the commonest route of infection was, and still is, very strongly held by many observers. There are, however, strong arguments against it. If it could be proved that the earliest seat of infection in the meninges was in the neighbourhood of the olfactory lobes, the argument in favour of the theory would be greatly strengthened; but Busse, who investigated the question very closely, came to the conclusion that signs of inflammation were observable quite as early in the lumbar region as at the base of the brain.

In a post-mortem experience of over 100 cases I have observed that the pia-arachnoid, in the region of the olfactory lobes, is practically always free from obvious infiltration. If this direct route is the way of infection, the meningococcus must spread up the sheaths of the olfactory nerves; it is not carried by the cerebro-spinal fluid.

Halliburton and Dixon have shown that particles of Chinese ink, dyes, etc., injected into the cisterna magna are carried outward to the nasal fossæ. This means that the meningococci would have to travel in a contrary direction to the circulation in the cerebro-spinal fluid. No one, however, has been able to demonstrate the presence of the meningococcus in the prolongations of the arachnoid or in the ethmoidal cells. A direct spread through the sphenoidal cells has been suggested, but offers much the same objections.

Flexner's experiments, dealing with the route of infection in acute anterior poliomyelitis, are of interest in this connection. Working with the higher apes, he was able to produce typical attacks of the disease by rubbing the mucous membrane of the

nasopharynx with morbid material derived from human cases, attempts to produce the same result for cerebro-spinal fever by painting the nasopharynx with cultures of the meningococcus proving unsuccessful. It must be mentioned that injections of cultures into the blood-stream proved equally futile, and that only the subdural inoculation could produce the characteristic changes of this disease. Subdural inoculations of other organisms produced similar lesions. On the other hand, intravenous injection of pneumococci into guinea-pigs causes death, not from pneumonia, but from intense septicæmia.

It will be seen that, so far, animal experiments have not assisted the solution of the problem. In discussing this question we must remember that while the infection of the meninges is the most obvious lesion in cerebro-spinal fever, we are also dealing with a generalised infection of the blood-stream. Advocates of the direct spread theory explain this as a leakage of organisms from the meninges, and hold that the blood-stream is secondarily infected.

In 1906, Andrews reported a case in which there was a marked condition of septicæmia, and from which the meningococcus was recovered from the blood in pure culture. In this case no involvement of the meninges could be demonstrated post-mortem. Elser and Huntoon found that 24 per cent. of their cases gave positive blood-cultures, and also showed that the proportion of positive results was greater the earlier the case was examined. If the infection of the blood-stream was secondary to that of the meninges, one would expect this finding to be reversed. Several other observers have demonstrated the presence of the organism in the blood before the symptoms of meningeal involvement have become at all marked.

During the present epidemic I have seen many cases in which there has been an intense septicæmia and in which the infection of the meninges has been comparatively slight. It has even been possible to demonstrate intracellular diplococci in a blood film taken from the finger in one of these cases, and blood-cultures are frequently positive. These cases are almost invariably fatal within twenty-four or forty-eight hours, and, post-mortem, show extensive hæmorrhages into the skin and internal organs, most notably into the adrenal glands. The infection of the meninges varies but is rarely extensive. Here one must consider that there is a primary infection of the blood-stream and that the infection of the meninges is secondary. There is another class of case which I

have observed in this epidemic, and which is more easily explained by the theory of infection viâ the blood-stream. In this the patient becomes acutely ill, with signs of general toxæmia, headache, vomiting, rise of temperature, cardiac dilatation, etc., but no signs of meningitis. This condition may last for one, two, or three days, and then symptoms of meningitis appear.

If we allow it to be possible that the organism enters the blood-stream, and that the meningococcus has the same predilection for the lepto-meninges that the pneumococcus has for the lung and the bacillus typhosus for the lymphoid tissue of the small intestine, then the problem of the route of infection will be solved, and we will be able to understand better many of the questions of pathology and symptomatology that otherwise appear difficult.

The occurrence of suppurative arthritis and pericarditis has been advanced as a proof of the blood-stream theory, but as these are late manifestations of the disease, it is probable that the infection in these cases is secondarily derived from the meninges. One objection to the blood-stream route of infection is the lack of signs of inflammation in the nasopharynx, and the possibility of infection through a normal mucous membrane has been doubted. As we have seen, the normal state of the nasopharyngeal mucous membrane in cerebro-spinal fever is more apparent than real, and, in any case, the passage of the organism into the general circulation without any or, at most, slight local evidence of infection is by no means uncommon.

Cerebro-Spinal Fluid in Cerebro-Spinal Fever.

In the great majority of cases a degree of turbidity appears. This varies from the slightest opalescence to thick pus of the consistence of pea soup. In the earliest stages the fluid may be quite clear, and also in some of the fulminant cases. As a case progresses towards recovery the fluid becomes clearer and clearer, until it resumes its normal condition. In some chronic cases it also becomes clear, in others it assumes a yellowish colouration. This colouring matter is probably of the nature of a lipochrome, and is soluble in chloroform.

The quantity of fluid is always increased, 50 to 80 c.c. being usually obtained by lumbar puncture in the acute stage, and up to 120 c.c. in some chronic cases. The pressure in the subarachnoid space is increased up to 300 to 400 mm. of water, and exceptionally, even to a greater extent. This is shown by the

rate of flow from the lumbar puncture needle, the fluid flowing out in a continuous stream, or even spurting out to some distance. In estimating the increase of pressure due to disease, allowance must be made for the rise due to an anæsthetic, if one is employed. The rise due to this cause may amount to half the normal pressure.

Changes in Chemical Composition.—The normal alkalinity is said to be reduced, owing to the increased amount of lactic acid present. The amount of chlorides, etc., is in excess of normal. The quantity of glucose varies. In the usual type of acute case, with a fair amount of turbidity of the cerebro-spinal fluid, it is absent, appearing again as the fluid clears, until the normal amount is regained. In very early cases, and in those acute cases in which the fluid is clear, it may be present in normal amount.

The presence or absence of glucose in the cerebro-spinal fluid is of some value in differentiating the various forms of meningitis—(1) In pyogenic meningitis sugar is invariably absent; (2) in cerebro-spinal fever, absent in acute cases, returns as the infection recedes; (3) in tuberculous meningitis sugar is present, except just before death; (4) in poliomyelitis it is present.

The turbid fluid reduces a solution of potassium permanganate. The albumin content is increased after the very earliest stages of the disease. Serum albumin and serum globulin are present in varying amount, as can be demonstrated by the usual tests (boiling, cold nitric acid, Noguchi, Nonne, etc.).

Changes in Cell Content.—An initial lymphocytosis is described by many writers. Cerebro-spinal fluid obtained in the earliest stages of the disease shows the presence of a few lymphocytes and a varying number of free meningococci. The lymphocytes do not appear to be more numerous than those present normally, and they are most commonly seen in those extremely fulminant cases in which there is little time for any reaction to take place.

The most characteristic picture in cerebro-spinal fever shows an almost pure polymorphonuclear exudate, the polymorph leucocytes totalling up to 100 per cent., and containing a greater or less number of meningococci. In some fluids each leucocyte is crammed with organisms—as many as fifty cocci may be present in one cell—in others the organisms are not so abundant, but they can usually be demonstrated. Extracellular cocci are usually present to some extent. The polymorphonuclear cells are of the

neutrophile variety, eosinophiles being completely absent. There are also usually present one or two lymphocytes and an occasional large mononuclear endothelial cell.

Later in the course of the disease the picture becomes modified. Lymphocytes become more numerous and the number of diplococci is greatly diminished, until finally they cannot be demonstrated. If the case progresses favourably, the total number of cells becomes lessened, but the lymphocytes are relatively increased, and finally predominate in numbers. An increased number of lymphocytes persists long into convalescence, but the exact point at which the cell content becomes normal is not exactly ascertained, and probably varies in each case. As the cell picture is studied from day to day during the course of the disease, these changes may be followed. However, it will sometimes be noticed that the number of polymorph cells varies from day to day, being temporarily increased in the later stages for no apparent reason, even in cases proceeding favourably.

The meningococci usually disappear after the first week, but an increase in the number of polymorph cells may be accompanied by their reappearance. In cases which do not proceed favourably, the number of cells does not diminish, nor does the proportion of lymphocytes increase to the same extent. The number of cells may so increase that the whole spinal subarachnoid space becomes occluded by exudate of a thick cheesy consistence. When chronic internal hydrocephalus develops, the cell content becomes extremely low, and the cells present are mostly lymphocytes.

The number of cells present in the cerebro-spinal fluid may be counted in a hæmocytometer, but for practical purposes it is sufficient to watch the degree of turbidity, or to measure the amount of deposit formed on standing.

It is important to note that changes in the cerebro-spinal fluid are evidence of changes in the meninges. In order that we may follow the course of the disease, we must try to understand the significance of the changes described above. The free meningococci have escaped from the meninges during the infection from the blood-stream; the result of this infection is an intense infiltration of the meninges, especially round the capillaries, with polymorph leucocytes. We have evidence of this in the polymorph exudate in the cerebro-spinal fluid. The diplococci are now mainly intracellular. In the later stages of the infection the infiltration becomes lymphocytic in character, and so does the exudate.

As the infection dies out, the meninges and the cerebro-spinal fluid return to normal.

With regard to the chemical changes, the albuminoid degeneration which occurs in the cells of the choroid gland interferes with its selective and protective action. Serum albumin and serum globulin are allowed to pass into the cerebro-spinal fluid from the blood-stream. The amount of chloride is increased for the same reason. The fate of the glucose is not certain. Kopetsky holds that it is fermented by the growth of the meningococcus, and that this causes an increase in the amount of lactic acid present.

As the condition of the choroid gland and the meninges returns to normal, so does the chemical content of the cerebro-spinal fluid. The foreign products present are removed by phagocytosis or by digestion until the simpler end-products can be absorbed. In frequent examination of the cerebro-spinal fluid we have a more reliable guide to the course of the disease than any other at our disposal.

Course of the Disease.

Clinical Types.

Infection by the meningococcus runs such a varying course in the different individuals attacked that any classification must be incomplete. It is only possible to describe the course of certain cases and to indicate how others may differ from the selected types. An acute case of cerebro-spinal fever may end in recovery, death, or may become chronic. In this last instance the signs and symptoms are due to the persistence of a condition of internal hydrocephalus, which is now due, more or less, to mechanical causes.

The acute cases may be classified as follows:—(1) Fulminating cases. (2) Ordinary acute type. (3) Suppurative cases. (4) Abortive cases. (5) Mild cases. (6) Posterior basic meningitis.

1. *Fulminating Type.*—In this class may be included those cases in which there is an exceedingly abrupt onset, and in which death usually occurs in forty-eight hours. The cases of this type may be divided into two classes. We have already noted that cases have been described by Andrews and others in which there was an intense bacteræmia, caused by the meningococcus, without any infection of the meninges. While these cases are rare, it is not at all uncommon to find others very similar, in which the meningeal infection is slight, and which apparently succumb to

the general infection before the lesions of the meninges have time to develop. Other cases of this fulminating type show a very rapid and extensive purulent infection of the meninges, along with symptoms of intense general septicæmia.

The characteristic morbid change in these two classes of the fulminating type consists in a hæmorrhagic rash and extensive hæmorrhagic destruction of the adrenal glands. In the first class of case the onset is extremely abrupt, and is characterised by headache, vomiting, and rigors. The person attacked is prostrated from the onset, but remains quite clear mentally. Within an hour or two a profuse purpuric rash makes its appearance, and there is well-marked cardiac failure. This becomes more and more marked, with intense cyanosis, until for a considerable time before death no pulse can be felt at the extremities, and the heart sounds become fainter and fainter. The respiratory movements are comparatively unaffected, and the patient remains perfectly conscious to the end, even after the heart's action has apparently stopped. In the second class of case, after a similar onset, unconsciousness rapidly sets in, and in a few hours the patient is in a state of coma. While the special signs of meningitis may, at first, be present, a stage of complete muscular relaxation soon follows, and frequently this is present from the first. The purpuric rash rapidly appears, the breathing becomes stertorous, and the heart more and more embarrassed. Death does not occur quite so quickly as in the first class of case, where the whole course of the disease may not exceed twelve hours, but usually occurs within thirty-six to forty-eight hours. These two classes are not sharply divided, and many intermediate cases may be met with. The proportion of this type amounts to about 10 per cent. of my series.

The peculiar symptomatology of this type is largely due to the lesion of the adrenal glands. The function of the medullary portion of these glands is to secrete a substance—epinephrin—which is instrumental in maintaining the tone of the vascular system. The withdrawal of this substance from the circulation brings about a great fall of blood-pressure, and hence the disappearance of the radial pulse, and eventually the failure of the cardiac action. In this connection it is interesting to note the developmental origin of the adrenals from the primitive central nervous system of the embryo, and the marked predilection of the meningococcus for the central nervous system and its coverings in postnatal life.

2. *Ordinary Acute Type.*—The onset of these cases is abrupt, with headache, fever, and vomiting. These symptoms may have been preceded by a prodromal period, but most frequently the patient has been in perfect health up to the commencement of his attack. Shortly after the onset of the attack, usually within an hour or two, symptoms of meningeal involvement appear. The headache and fever continue, stiffness of the neck muscles appears, accompanied by pains radiating from the small of the back, and hyperæsthesia along the vertebral column. The tongue is dry and furred, but the vomiting has most commonly ceased. The patient lies on his side with his knees drawn up, and changes his position slowly and with evident difficulty; his facial expression is strained and anxious, and he looks ill. The pulse-rate is slightly increased; Kernig's and Brudzinski's signs can be demonstrated. The reflexes, superficial and deep, are probably present early in the disease, and may be exaggerated; later, in fairly severe cases, they are lost. Ankle clonus may be present early, but seldom later. In most cases the mental condition is fairly clear, but the patient may be irritable or stupid, or, in more severe cases, unconscious.

Mild delirium is common, especially at night, and a certain number of cases are wildly restless and require forcible restraint. There is frequently incontinence of urine and fæces, but the incontinence of urine may be only apparent, as the result of the overflow of a full bladder. These signs and symptoms persist for several days, the duration of the acute stage being from five or six days to about a fortnight. Then the case may progress towards recovery, end fatally, or become chronic. In the first instance, gradual improvement in all the symptoms occurs—the mind becomes clearer, the temperature falls, usually by lysis, and the appetite returns. For some days after the temperature has fallen and the symptoms have disappeared, Kernig's sign can still be demonstrated, and convalescence is not safely established until this is no longer the case.

In a case which is going to terminate fatally, the signs and symptoms persist—the temperature does not fall, but remains high and irregular; the pulse-rate increases, and also the respiratory rate; delirium becomes more marked, the patient may become restless, and picking at the bedclothes may be noted. For some time before death profound unconsciousness is the rule, with complete incontinence of urine and fæces. Just before death the temperature may reach a hyperpyretic level, the respirations

show variations in rate and rhythm, and the pulse becomes small and fast.

In those cases which become chronic the condition present is almost always one of internal hydrocephalus. This condition will be discussed elsewhere. It is in this type of case that the various erythematous rash may be observed, and in quite a few a scanty petechial rash may appear. This never assumes the larger purpuric form of the fulminating type.

In a few cases, after a typical abrupt onset, the symptoms largely subside, leaving a certain degree of headache and fever, with signs of cardiac failure. Two or three days later typical signs of meningeal involvement appear and the disease runs the ordinary course.

3. *Suppurative Cases.*—During the first few days of the illness these cases cannot be distinguished from the ordinary acute type. After a few days it will be noticed that the case is not responding to treatment, and, above all, that the cerebro-spinal fluid is daily becoming more and more purulent, until finally it will not flow through a lumbar puncture needle. Frequently, at this period, the general symptoms are greatly improved—headache is slight, and the patient feels better. However, delirium persists at night, and the mental condition is more and more affected; vomiting recommences, and finally a condition of internal hydrocephalus is established. Five per cent. or 6 per cent. of my cases have been of this type.

4. *Abortive Cases.*—In these cases, following on abrupt onset, severe symptoms of meningeal involvement appear. The patient is unconscious, probably very restless, and the appearance presented is somewhat similar to the second class of fulminating cases previously described. The respirations are laboured and there is well-marked cyanosis, but the hæmorrhagic rash does not appear. The temperature is moderate and the pulse is slow. The cerebro-spinal fluid is found to be under great pressure and is moderately turbid.

The immediate response to treatment is the most gratifying feature of these cases. After the subarachnoid space has been drained, and the anti-meningococcal serum injected on one, two, or three successive days, there is rapid improvement in the symptoms. The patient becomes conscious, and does not complain of headache; cyanosis disappears, and the temperature falls to normal. The cerebro-spinal fluid quickly becomes clear, and convalescence is usually rapid and complete.

It will be noted that most of the severe features of the symptomatology of this type are those due to greatly increased intracranial pressure, *i.e.* acute internal hydrocephalus. The immediate relief of this condition by lumbar puncture probably explains the favourable course of the disease in these cases.

5. *Mild Cases.*—In a certain number of cases, notably towards the end of an epidemic, the disease runs a mild course. The onset is similar to that in acute cases though not so abrupt, but the symptoms of the subsequent stages are slight. The patient is perfectly conscious, and complains of moderate headache and pain in the back and limbs. There is a slight degree of neck rigidity, Kernig's sign is present, and the tendon reflexes are slightly exaggerated. The temperature is raised to 100° F. or thereabout, and the pulse-rate is slightly increased. No rash appears. The cerebro-spinal fluid is under slightly increased pressure and is very faintly turbid, and from it a few colonies of meningococci may be obtained on culture. While the course of these cases is almost always favourable, it must be remembered that complications—deafness and arthritis, etc.—may arise, though not as frequently as in the other types.

6. *Post-Basic Meningitis.*—This form of the disease occurs in infants, and I have had no opportunity of studying it during the present epidemic. In 1878, Gee and Barlow described a disease occurring in young children, characterised by initial fever and vomiting, followed by marked head retraction. Most of their cases ran a prolonged course, with great retraction of the head, opisthotonus, wasting, and tonic spasm of the limbs. Post-mortem, inflammatory exudate was found at the base of the brain and there was great dilatation of the cerebral ventricles. In 1898, Still isolated a diplococcus from the exudate, which was later identified with the meningococcus. Gee and Barlow first described their cases as occurring sporadically, but more recently they have been noted during the course of an epidemic of cerebro-spinal fever.

It is more than probable that post-basic meningitis is merely one type of cerebro-spinal fever, the variations in symptomatology being due to anatomical causes, chiefly the unossified condition of the skull, which occurs in infants.

(*To be continued.*)

CLINICAL RECORDS.

THREE CASES OF AXILLARY VEIN OBSTRUCTION.

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WITHIN a period of just over two years three cases of axillary vein obstruction have come under my care, and as the condition is not a common one they are placed on record.

All three cases were similar in the following respects:—The right-sided vessel was affected; the patient was an athletic muscular man in perfect health; he had recently been employed on heavy work; there was no history of an acute infectious fever, or of venereal disease; there was cyanosis with engorgement of the superficial veins; the limb was swollen and tense but there was no œdema; there was no constitutional disturbance, and both temperature and pulse-rate remained normal.

One of the cases was quite free from pain, nor had he any tender area, while the other two had both of these. In two of them all Röntgen shadows in the neighbourhood were proved to be normal; the other case was not X-rayed. In two of the cases recovery was practically complete; in the same two the axillary vein only was blocked; in the one remaining the axillary artery was also partially involved.

Pathology.—In Cases I. and II. the condition was certainly one of thrombosis of the axillary vein. The lesion was most probably in the first part of the vessel, *i.e.* in the region between the medial border of the pectoralis minor and the outer border of the first rib. I suggest that the vein had somehow suffered damage against the rib border during vigorous exercise, and that the intima of the vessel had been injured, thus determining the occurrence of a thrombosis.

In Case III. diagnosis was more complicated. There was a swelling in the axilla, which had probably first appeared four years before and had increased slowly in size. It was not likely to be inflammatory, otherwise it should have broken down in this time; further, there was no cervical adenitis. It should have been therefore a benign tumour and a non-osseous one; to produce the nerve irritation it must have been firm, and to include the vessels

and nerves it must have been a fairly broad mass. I think it was adherent to the vessels, particularly the axillary artery, which became acutely kinked, and had its lumen occluded, when the arm was raised vertically; most probably the axillary vein obstruction was a flattening out of the vessel across the tumour rather than a thrombosis, because the onset was so gradual the venous engorgement was never very marked and there had never been much swelling of the limb. The source of irritation was linked up with the shoulder joint, for internal rotation (placing his hand behind his back) caused pain. The subscapularis bursa and the synovial cavity of the shoulder joint normally communicate. Internal rotation of his shoulder probably made any bursal swelling more prominent; such a swelling could cause the "pins and needles" in his thumb through irritation of the fifth cervical nerve elements in the lateral cord of the brachial plexus where it lies external to the second part of the axillary vessels. I suggest, therefore, that he had a hard fibroma of the bursa under the subscapularis tendon.

Case I.—On the 26th June 1915 I was asked by Dr. Astin to see with him, in consultation, H. R., aged 22, a civilian ship's steward, in the Royal Naval Hospital Ship *Drina*.

The previous night the patient had gone to bed quite well; that morning he had awakened to find that his right upper extremity was swelled up and discoloured. The limb felt heavy and he had difficulty in using it; it was quite painless. He had always been healthy previously; there was no history of any accident, of venereal disease, of cough, of typhoid or any other infectious fever. For a fortnight previously he had taken a good deal of alcohol, which he was unaccustomed to, and he had been having an extra amount of physical labour which involved him lifting heavy ship stores. He attributed a combination of alcohol and hard work for the arm condition.

On examination the right upper extremity below the level of the point of the shoulder was uniformly swollen and deeply cyanosed. The superficial veins of the infra-clavicular region and of the whole limb were generally enlarged and engorged. On palpation the circulation proved to be sluggish, the tissues were tense, but no œdema was observed on pressure. No tender spot could be discovered; there was no anæsthesia, and the radial pulse was normal. Nothing abnormal could be heard on auscultation, either over the subclavian or the axillary arteries; there was no thickening of the arterial walls. The heart sounds, breath sounds, urine, pupils, knee jerks, and vertebral movements were all normal. There was no evidence of any aneurysm along the palpable portions of the large arteries. The pulse-rate and

temperature were normal and remained so while the patient was under observation. Treatment consisted of rest with his arm in a sling. There was no change in his condition a few days later when he left the ship.

He returned to his home in the north of England and was seen shortly afterwards by Professor Rutherford Morison and Colonel Thomas Beattie of Newcastle-upon-Tyne, both of whom agreed with my opinion, but they informed me that they were unable to assign a cause for the axillary vein thrombosis. X-rays showed that the first rib, the clavicle, and scapula gave normal shadows; there was no trace of aneurysm or of a cervical rib.

After-Progress.—He kept his arm in the sling for ten weeks; improvement was very slow, and the swelling, with discoloration, persisted. He then began to work and immediately, he stated, there was an improvement which continued. In a letter dated 30th August 1916 he said he was then a storekeeper in some munition works, and "this work is pretty well as heavy as you would come across and I am working twelve and a half hours a day. The swelling has gone but the veins on the right side of the chest are very prominent. The arm seems as strong as ever, but when I have any heavy lifting, or if I take alcohol in any quantity, the veins in the arm and hand stand out and there is a good deal of discoloration." In a further letter, dated 3rd October 1917, he informed me that he had been called up as an Army recruit as a Class A man. He stated that the limb "swelled up and became discoloured occasionally when subjected to extreme heat and cold; there is a numbness all the time immediately behind the knuckle of the first finger; the arm veins are almost normal, the chest wall veins are still prominent. I am in fine general health and feel no weakening effects from the arm now."

Case II.—B. R. P., aged 21, was admitted to the Royal Naval Hospital Ship *Plassy* on 17th July 1916. He stated that on the previous evening while washing himself, after returning from a strenuous boat-pulling practice, he felt a sudden severe pain in the right upper extremity along the medial side of the arm and forearm. The pain "shot up and down," as he pointed out, along the course of the brachial and ulnar arteries. A few minutes later he noticed that the whole limb was considerably swollen and discoloured. There was no history whatever of cough, of typhoid or any other infectious fever, of injury, or of venereal taint. For some time prior to the onset of the condition he had been practising hard for a boat-pulling race in the Fleet Regatta. He had always been healthy previously.

On Admission.—He looked a robust, exceptionally well-developed man. The whole of the right upper extremity, from the acromion process downwards, was plum-coloured and considerably swollen.

The superficial veins of the limb and the adjacent portion of the chest wall, particularly in front, were abnormally prominent and distended. Upon palpation the limb was quite warm, and intermittent digital pressure showed poor circulation; the limb felt firm, but no œdema could be demonstrated. At a spot just below and internal to the right coracoid process was an acutely tender area the size of a shilling, where he could not tolerate palpation; there was no other area of tenderness. The radial pulses were equal in volume; there was no anæsthesia of the limb; no abnormal sounds could be heard on auscultation over the infra-clavicular area, the heart, or the lungs; the heart apex beat was normal; nothing abnormal was found with his pupils, knee jerks, or in his urine. He was not X-rayed, nor were a blood-count or a Wassermann test done.

After admission treatment consisted of the limb being swathed in strips of boracic lint, covered with alembroth wool and lightly bandaged. He was kept in bed with the right upper extremity immobilised in a vertical position. The latter was effected by suspending a pillow to the deck above, the lower margin of the pillow resting on the cot; the limb was loosely fixed by a towel pinned to the pillow, great care being taken that there was no point of local pressure. This vertical position was maintained for three days, by which time the cyanosis had gone, though the swelling and superficial venous engorgement remained. For the following week the limb was immobilised on an inclined plane formed of pillows; he was subsequently allowed to sit up, though he continued to have the arm supported as before. Seventeen days after admission he was discharged to his depôt hospital. By this time there still remained a little cyanosis of the limb; it was larger than the other one. The superficial veins were still prominent. The tender spot mentioned above had almost gone. During his stay on board neither pulse-rate, temperature, nor respirations varied from the normal.

Apparently recovery was complete, for nine months after the onset he was sent for service in Mesopotamia where he was killed in action.

Case III.—T. S., aged 32, stoker, was admitted to the Royal Naval Hospital Ship *Plassy* on 15th August 1917 complaining of pain in the right shoulder area. He was in perfect health until four years before, when he began to have an aching pain along the anterior aspect of the right upper extremity; at the same time the limb became numb and weak, so that he was unable to work. In civil life he owned a horse and cart which he drove himself. After a few days' rest the disability ceased, and so long as he refrained from heavy lifting work he was all right, for light work did not affect him. When it was "bad" the limb from the middle of the forearm downwards became a deep red colour and swelled up, as did the shoulder. It was much worse in the

winter, for he said the limb then became numb and useless. When the elbow was flexed to a right angle, with the arm held close to the chest wall and with the forearm midway between pronation and supination, he had "pins and needles" in the palm and right thumb; directly he altered the position this sensation disappeared. He could not sleep on his right side, but could do so in any other position; if he rolled on to the right side, the pain in the shoulder area wakened him up immediately. Recently the right shoulder joint was immobilised by tight bandaging; he said he had been much worse since. Placing his right hand behind his back caused pain in the shoulder. He was a "hostilities only" man, and joined up in January 1917. Since joining his ship he had only done one or two days' work as a coal trimmer; he had either been on light duty or on the sick list the whole time. He stated that he was a moderate drinker. He denied ever having had any accident, any septic focus on the upper limb, syphilis, rheumatism, or any infectious fever.

Signs.—He was a powerful, healthy-looking man. Neither temperature nor pulse-rate varied from the normal during his stay. The superficial veins of the whole of the right upper extremity and right side of the chest were distended; from the elbow downwards the limb was a dusky colour. On digital pressure the circulation was very sluggish; there was no œdema. All movements of the right shoulder joint were a little limited. No crepitus felt on moving the joint. When the arms were hanging down the radial pulses were equal; when the arms were raised vertically the right radial pulse disappeared and only reappeared when the arm reached a right angle with the body. With his hands placed behind his head the left subclavian and left axillary arterial pulses could be felt; the right subclavian pulse could also be felt, while the right axillary pulse could not be palpated. Rotation of the forearm (when raised) did not affect the disappearance of the radial pulse. There was no pulsation in the axilla suggestive of an aneurysm. With both hands behind his head there was fulness of the right axilla compared with the left one, and the right anterior axillary fold was fuller than the left-sided one. He would not permit deep palpation of the right axilla, as it was too tender; this did not cause "pins and needles" in the limb. There was an abnormal swelling deep to the second part of the axillary vessels and brachial nerves; I also thought I could feel an enlarged gland at a higher level. No abnormal bruit could be heard on auscultation of this area. The signs were much accentuated when he was examined immediately after he had been given some heavy lifting work to do in the wards. He was not given potassium iodide.

The hand grips were normal, as were the pupils; there was no muscle wasting nor any anæsthesia. The heart apex beat was in the fifth intercostal space in the nipple line. A systolic bruit could be

heard at the apex and was conducted outwards to the axilla; the second sound was duplicated at the pulmonary area. There was no general adenitis nor any spleen enlargement, and the urine was normal. X-rays failed to disclose any tumour of the first rib, of the clavicle, or of the scapula; neither was there a cervical rib. Both the Wassermann and von Pirquet tests were negative. Surgeon Simmins reported that the blood-count was normal, with hæmoglobin 90 per cent. and a colour index of 0·85.

SCURVY IN INFANTS.

By A. DINGWALL FORDYCE, M.D.

Within the past few weeks I have had under my care three cases of well-marked infantile scurvy—two in the hospital ward (both cases being from the country) and one seen in private (an Edinburgh baby).

Cases of advanced infantile scurvy are not common here, and the statistics of the Royal Hospital for Sick Children for the six years, 1910-1915 inclusive, show only three cases of scurvy. Slight cases in babies have, however, been more common among the well-to-do than among the hospital class. For the latter, the upbringing of a baby purely on a patent food or condensed or dried milk has been till recently of the nature of a luxury, and from the financial point of view impracticable. The baby has been fed wholly or partly on the breast or on some modification of fresh cow's milk, with usually odds and ends of what food was going.

Formerly it was the babies of the well-to-do who were reared on patent foods, and it was among the well-to-do that cases of commencing infantile scurvy occurred. In most cases, however, the danger was realised and precautions, as noted on the tins or bottles of food, were taken. At the present time, from more than one cause, the threatened danger appears to be one affecting no particular class in the community, and is a danger to be reckoned with not only in the nurseries of the rich but also in the consultations in connection with child welfare work.

Case I.—Baby A., male, aged 10 months, admitted to Royal Hospital for Sick Children with the complaint of "loss of power in the legs; pain on movement."

Previous Health.—Born at full time. Bottle-fed as follows:—(1) Cow's milk and water for one month, but did not thrive on this; (2) then given Horlick's Malted Milk for about ten days, but constantly vomited; (3) was then given Glaxo, but was very constipated while taking this,

and so when about 5 months old was put on (4) Allenbury No. 1, and throve much better on that. He has recently been given (5) Allenbury No. 2. He cannot yet sit up by himself. He cut one lower incisor tooth a month ago.

Present Illness.—Six or eight weeks ago the baby began gradually to lose the power of his limbs; before that he used to kick about quite freely. He became very quiet when left alone, but screamed when he was touched or moved in any way. Two or three weeks after the loss of power of the limbs was noticed there was swelling of both legs and feet. The arms, too, became very painful when moved, but he never lost the power of them and no swelling was noticed.

Physical Examination.—A very pale, puny little baby with sunken eyes; lies absolutely still as if frightened to move, and cries when touched. He lies with thighs abducted and slightly everted and knees flexed. One lower incisor tooth is cut and on the anterior aspect of the gum in front of the tooth there is a small purple spongy area. Swelling of both shoulder joints, especially the left; the left arm lies very limp and he screams when it is moved. Crepitus elicited at head of humerus. The natural curves of both legs in the vicinity of the knee are obliterated owing to hard swellings posteriorly. There is undue mobility of left anklé, with some crepitus. Examination of the urine shows the presence of red blood corpuscles. X-ray examination shows irregularities of the epiphyses at the shoulders, especially the left, and of the femora. Hæmorrhages under periosteum of both humera, at lower end of left radius, and both tibiæ. Effusion into both shoulder joints. Temperature, 101°; pulse, 160; respirations, 58.

Course and Treatment.—He was put upon a diet of scalded milk and water and was given two teaspoonfuls of potato cream three times a day. Two days later he seemed rather less afraid of being touched, and four days later his temperature was under 99°; he was much less afraid of being touched, and the swellings of the limbs were markedly less. He thereafter began to show various signs of improvement; he began to smile frequently, he developed some colour in his cheeks, he ceased to cry when bathed, and he gained a little weight. He was given fruit juice four-hourly, and farola was added to his diet. He later suffered from bronchitis and a septic skin condition, but five weeks from the date of admission to hospital he was discharged well.

Case II.—Baby B., male, aged 9 months, admitted to Royal Hospital for Sick Children with complaint of "fretfulness and stiffness of the legs."

Previous Health.—Natural birth and healthy baby. Was never nursed at the breast. Bottle-fed (1) cow's milk for four weeks, but suffered from diarrhœa and vomiting, and so when aged 4 weeks was given (2) Nestlé's Milk. He was fed irregularly on this and vomited

after each bottle; (3) at fifth month was put upon Allenbury No. 1, and fed regularly. He throve much better, had no diarrhœa or vomiting, and gained in weight. He had nothing wrong with his legs and could kick about quite freely. He cut two lower incisor teeth quite recently.

Present Illness.—When baby was 7½ months old the mother noticed that he could not move the right leg freely. There was no constitutional disturbance—appetite good, bowels regular, no vomiting. A few weeks later the left leg became similarly affected. For several weeks he has been very fretful and perspires a great deal.

Physical Examination. — A very fretful, pallid baby. Numerous petechiæ present on face, body, and limbs. Two lower incisor teeth are cut, and there is a somewhat purplish discoloration of the gum around them. There is diffuse swelling over both knees and the patellæ cannot be palpated. Movement at the knees causes pain. There is also some swelling over the right tibia and lower end of the right femur. Slight swelling and tenderness in the region of both wrists. The urine contains a few red blood corpuscles. X-ray examination was somewhat unsatisfactory, but showed apparently effusion into both knee joints. Temperature, 101°; pulse, 140; respirations, 56.

Course and Treatment.—He was put upon a diet of scalded milk and water and given orange juice thrice daily. The swellings diminished; the temperature remained at normal after four days; he began to smile, to move his legs freely, and his colour improved. He was discharged in seventeen days very well.

Case III.—Baby C., male, aged 12 months. This baby, who had been healthy at birth, was fed on Nestlé's Milk for a few weeks, and thereafter received nothing at all except Allenbury Nos. 1 and 2. For several weeks he had been very querulous and fretful, apparently suffering constant pain. He had gradually lost the power of his legs, and resented touching or moving. His upper and lower incisor teeth were present, and surrounding them the gums were swollen, reddish-purple, and bleeding. The baby was very pale and emaciated, had a sunken appearance, and looked very ill. A diet of scalded milk and water was recommended; he was given potato cream and grape juice, and he made a rapid and uninterrupted recovery.

The following points are noteworthy in connection with these cases:—

1. The patients were aged respectively 10, 9, and 12 months.

It is during the second half of the first year of life that we have particularly to be on the outlook for the development of scurvy. Under 6 months of age it is uncommon, as the causative

factor requires to be in operation some considerable time; over 12 months of age it is uncommon, because most babies before reaching that age receive fresh food of some kind.

2. In each of these cases there was a history of the long-continued use of patent foods.

3. In two of the three cases feeding was first attempted by means of cow's milk, discontinued because of digestive trouble, and resort subsequently had to a proprietary food. We all know the value of patent infant foods in cases of illness and recognise that many of them are more readily digested than fresh cow's milk. But most babies can take fresh cow's milk if from the commencement they are fed regularly, in suitable quantities, and in suitable dilution. Undoubtedly all artificial baby-feeding must, to begin with, be considered of the nature of an experiment. We may consequently look upon it as wise to make the first step by means of some such readily digestible food as condensed or dried milks, *e.g.* Nestlé, Glaxo. There is much to be said for such an initial move. We realise that the common initial digestive difficulty in the case of a bottle-fed baby is connected with the fat in milk, and that such condensed and dried milks, when appropriately diluted, give us a fat-poor food. They are a useful step to something better, but they are a step only, and should in most cases, in the course of a few weeks or a month or two, when the baby is older and stronger, lead up to stronger food. If still continued, they should certainly be supplemented by fresh fruit juice or potato cream (as recommended by the vendors).

4. It is important to recognise early symptoms and to commence treatment before gross changes have occurred and the baby is emaciated and worn out with prolonged suffering. The dietetic history gives the clue to the diagnosis. If it cannot be elicited, tenderness on movement of a limb in an infant between 6 months and 1 year of age should always make us consider the possibility of scurvy. The symptoms of osteomyelitis are more acute; syphilitic epiphysitis occurs at an earlier age. Infantile paralysis is, after the onset, a painless condition. Rickets is a common accompaniment of scurvy, but the tenderness and the paretic symptoms are less marked in rickets and the characteristic vascular changes of scurvy are lacking.

5. Early treatment ensures rapid recovery. When treatment is delayed till the condition is marked, general nutritional weakness favours complications and retards recovery.

THE TRAINING OF THE STUDENT OF MEDICINE:

An Inquiry Conducted under the Auspices of the Edinburgh Pathological Club.

III.—BOTANY IN MEDICAL EDUCATION.

By Professor BAYLEY BALFOUR.

I take it the object of your discussion is, by carefully reviewing the whole medical curriculum, to find out whether the student during the all too short time that he is at the university really employs his time to the best advantage, and whether, always bearing in mind that the medical degree is something more than a mere technical licence to practise, by any rearrangement of the curriculum—by reduction or excision of subjects, or by other methods—it may be possible to give the student a more advantageous training than he has at present for the great profession on which he is about to embark. I shall say a few words on the subject of botany in this connection.

All questions of improvement of education and training resolve themselves into one of matter and one of method. And in considering the subject of botany in relation to medicine one has to recognise that there are certain branches of it which are more directly and practically useful to the medical student—the equipment branches we may call them—and there is the broad fundamental educational side.

As regards *matter*, there is no doubt that the equipment branch brought botany into the medical curriculum. Some years after the physicians had founded in 1670 the Edinburgh Botanic Garden in order to teach practical materia medica, the university introduced botany as a Chair—the foundation chair of the medical faculty. Since then things have marched far, and materia medica has hived off from the main subject of botany and is more effectively taught at a more advanced period of the student's curriculum by the professor of materia medica. At the end of last century another equipment branch came to the fore—bacteriology. How short was the view taken by the University Commissioners of the progress of medicine when they not only refused to institute a lectureship to deal with bacteriology in my department, but also refused assent to a scheme through which teaching of bacteriology could have been provided in another way. In consequence of the peculiar relationship between the university and the Botanic Garden the Treasury, after inquiry by a committee, agreed to the proposal under which the Treasury would maintain the botanical teaching of the University of Edinburgh in all its branches, provided that the university would transfer the fees of botany students to the

Government. The negation by the commissioners of this proposal was, I am afraid, prompted by financial rather than by educational considerations. And so it is only, as you know, within very recent years that a Chair of Bacteriology has been established, and I, too, have a lectureship in my department. But bacteriology can be taught in my department only as part of the whole subject of fungi; the pathogenic side cannot appeal to the medical student until a much later period in his curriculum.

Equipment branches tend to hive off from the main subject as these have from botany, and who shall say what other subjects in connection with plant life will in future bulk more largely in relation to medical education; doubtless they too will hive off to the control of independent lecturers. After removing all these equipment branches you have still the broad educational side of botanical teaching—the knowledge of plant life—to put before the medical student. The method of presentation of this must always be a reflection of the personality of the professor for the time being, but his teaching must deal essentially with the broad facts of plant life as part of the environment of man, and stimulate the imagination of the student by interesting him in the great problems of evolution and in the fundamental facts of inheritance and heredity generally. In all this there is ample material of direct use to the medical student, apart altogether from the educational value of the study of such a subject as botany at the outset of a boy's university career, fresh as he is from school, where he has been impressed by authority and has not had to deal with evidence.

As regards *method*, I would, in the first instance, point out as a handicap under which the majority of medical students suffer in the study of botany the lack of knowledge of chemistry and physics. When one endeavours to present to him a picture of the green carpet of the earth as the great circulator of carbon, or of fungi as circulators of nitrogen, the boy who has never heard of carbon or nitrogen gets a very imperfect impression of what one wants to convey. And the boy who knows nothing of barometric pressure or of osmosis cannot really appreciate the work of plant life. I am strongly of opinion that an important change—though I do not suggest how it might be brought about—in our curriculum would be one ensuring that all boys coming to study botany at the university have some knowledge—very elementary perhaps—of chemistry and physics. If school education be improved, perhaps the alterations in it would suffice for this purpose.

In view of overcrowding of the curriculum, it has been suggested that botany and zoology might be combined and taught as one subject—biology. There could be no greater mistake. The term "biology" was introduced into education by Huxley about the sixties of last century for a course instituted for the purpose of teaching science students going on to a further science curriculum, and it occupied a full

year, and when I tell you that the assistants Huxley enlisted in the service of his course were Burdon Sanderson, Michael Foster, William Rutherford, Ray Lankester, and Thistelton-Dyer, I think you will recognise that that course was far beyond anything implied by the term "biology" when used to designate a substitute in medical education for the two subjects of botany and zoology. Biology was introduced in many institutions as a substitute for botany and zoology; I am disposed to think that financial rather than educational considerations led to this—it saved a Chair. The practical outcome has been that the biological teaching in these institutions has been divided between a botanist and a zoologist; and now in some cases there has been reversion to separate and independent teaching. Apart altogether from this failure in practice, I hold that biology is a bad name for such a course; it does not mean what it implies. It confuses real issues, because the plant organism and the animal organism in the higher grades are absolutely different; and whilst the laws of life are the same everywhere, the special relationships of the plant and of the animal organism to its environment and to everything else are of a different character. I would say, therefore, that if the time given to botany and zoology must be reduced, let it be done by halving each course and let each go on independently of the other, rather than hybridise them under the name of biology.

It has been suggested that the medical curriculum might be relieved and more time released for other subjects were botany and zoology relegated to school teaching. That is a very important point, and one that has come prominently forward recently. The Medical Council some years ago spoke of it. If you ask me, Could botany and zoology be taught in schools just now? I say emphatically, No. There are no teachers, there is no equipment. After the war the teaching of science will, without doubt, be largely introduced into our secondary schools —to what extent no one can say at present. It is significant that in all these years of dominant humanistic education Greek has not become a subject in all school areas. I am of those who hold that science teaching in schools ought to be primarily observational; the pupils should learn about what they see in the earth, the sky, and the sea, and something about the inhabitants of these and the relationships between them. I think that systematised laboratory work and teaching in botany should only be introduced at the end of a boy's period at school; even so, the atmosphere of the school is not nearly so good a one for such teaching as that of the university. If, however, the organisation were perfected, if the equipment were adequate, if the teachers were adequate, and if sufficient time without injury to other essentials could be obtained for the teaching of botany at school just before the boy entered the university, the question of relegation would require grave consideration. The teaching could only be introduced for pupils of a leaving age

and would have to be so co-ordinated with the teaching of other science that the boy's time would practically need to be given over to it. Where is the advantage? It is better to send a boy straight to the university than to give him a whole year's science teaching in the last year at school. He will get a wider outlook on science at the university than he will at school. While I am willing to consider any schemes for the school teaching of botany that will suffice for the medical student when all the provision is made for it, I cannot but think that on general grounds it would be essentially a retrograde step. It would tend to narrow the student's view-point, and he would enter upon his medical career much less well equipped than he is at the present time.

Another consideration is, that the first year of medical study in our university—given to what we call the foundation science studies—is of the greatest value to the medical student in shaking him down to university study. At present, a boy entering my class will ask, How much have I to learn for to-morrow? He has yet to rid himself of the idea that he is still working under direct tuition and to realise that for the first time in his life he is free to observe and to look out upon his surroundings untrammelled by any doctrines or any authority that has previously been imposed upon him.

My own view is that we need another year added to the curriculum. When you consider the grave responsibilities that a medical man has to face in his work, and when you consider the relative importance of medicine and other professions, most of which require five years for qualification, surely a sixth year would not be too much to ask for medical students.

IV.—THE CONNECTION OF ZOOLOGY WITH MEDICINE.

By Professor J. COSSAR EWART.

Very little has been said in Scotland as to the connection of zoology with medicine, and, except in the writings of Huxley, the subject has received little attention in England. It is admitted on all hands that would-be healers and preventers of disease, before beginning the study of the purely professional subjects of the medical curriculum, should have the advantage of a liberal education. It was long assumed by many that a liberal education could only be obtained by the study of classics—mathematics, physics, literature, and philosophy. One of the main objects of education should be so to develop the brain that when maturity is reached the output of brain work will be as great as the structure and composition of the brain renders possible. It is being more and more realised that we differ as much mentally as we do physically, and that brains of a very high order may fail to respond to the stimuli of either classics or mathematics and yet respond immediately and effectively when, *e.g.*, biology is substituted for mathematics.

As it happens, the attitude of many educationalists has fortunately been so profoundly changed since the war began that the time may not be far distant when no Arts or Science curriculum will be considered complete unless it includes biology, and when a medical degree will only be conferred on students who have previously taken a degree in Arts or Science. When this time comes it will no longer be necessary to consider the connection of biology with medicine.

In Edinburgh it seems to have been possible from the outset to graduate in Arts without professing any acquaintance with biology. On the other hand, in Oxford and Cambridge it is impossible to graduate in Medicine without first obtaining a degree in Arts, which includes among the subjects professed botany and zoology. Further, until a few years ago all Arts students in Aberdeen were required to study and to pass an examination in zoology. Huxley, in his rectorial address to Aberdeen students, expressed satisfaction with the inclusion of zoology in the Arts curriculum, and I often heard Matthews Duncan assert that the course of lectures on natural history in Aberdeen did more to develop his brain than all the other subjects of the Arts curriculum. Though Huxley was always dilating on the advantages of a knowledge of biology, and pointing out that zoology more than any other subject helped one to understand man's place in Nature, he is often quoted in support of the view that zoology should be reduced to a minimum or banished altogether from the medical curriculum. In an address delivered in 1854, Huxley, after pointing out that the systematic teaching of biology cannot be attempted with success until the student has attained a certain knowledge of physics and chemistry, proceeded to say: "Biology needs no apologist when she demands a place—and a prominent place—in any scheme of education worthy of the name. Leave out the physiological (*i.e.* biological) sciences from your curriculum and you launch the student into the world undisciplined in that science whose subject-matter would best develop his powers of observation."

In 1870, Huxley discussed medical education at University College. In 1870 he was advocating the teaching of physics and chemistry in elementary schools, and perhaps dreaming of crowds of students flocking to South Kensington to study zoology by way of putting the finishing touch to their general education. In the University College address Huxley said: "I have no doubt that botany and zoology ought to be got rid of as branches of special medical education; they ought to be put back to an earlier stage and made branches of general education."

Eleven years later it fell to Huxley's lot to address the International Medical Congress. After referring in this address to the important part played by parasitic organisms in the etiology of disease, he said that there could be no question as to the value of the

connection between medicine and the biological sciences; that the future of medicine depended on the extent to which those who occupy themselves with these subjects are trained in the methods and impregnated with the fundamental truths of biology, and he concluded a weighty and impressive oration in the following words: "I venture to suggest that the collective sagacity of this Congress could occupy itself with no more important question than with this: How is medical education to be arranged so that, without entangling the student in those details of the systematist which are valueless to him, he may be enabled to obtain a firm grasp of the great truths respecting animal and vegetable life, without which, notwithstanding all the progress of scientific medicine, he will still find himself an empiric."

To be in a position to understand Huxley's attitude in 1870 one must bear in mind that at that time the course of zoology at University College was somewhat antiquated. One of Darwin's fellow-students in Edinburgh was Robert Grant. Darwin often accompanied Grant to collect animals in tidal pools and to hear on the way much about evolution as conceived by Lamarck. In course of time Grant was appointed Professor of Comparative Anatomy and Zoology in the University of London. Unfortunately Grant, after settling in London, to use Darwin's words, "did nothing more for science," and, more unfortunate still, he lectured to students on comparative anatomy. Of the course of 60 lectures published by Grant, 15 were on the osteology of vertebrates, 8 dealt with organs of motion, 5 with the nervous system and sense organs, 20 with digestive, circulatory, respiratory, and secretory organs, and 12 with the organs of support in invertebrates. It is hence not surprising that Huxley in 1870 said at University College that zoology should be got rid of—"that it was in fact a downright cruelty to require from gentlemen who are engaged in medical studies the pretence . . . of a knowledge of comparative anatomy as part of their medical curriculum."

Huxley, it may be mentioned, was making arrangements in 1870 to give his first course of practical zoology. Rolleston, partly inspired by Huxley, had just published his epoch-making work on *Forms of Animal Life*, and already in 1872 the type-system of teaching zoology, so intimately associated with Rolleston and Huxley, was causing considerable stir amongst biologists in London. Huxley's course on practical zoology at South Kensington (conducted with the help of Michael Foster, Burdon Sanderson, and Ray Lankester) proved the forerunner of a course at University College of experimental physiology. At the beginning of the nineteenth century teachers of physiology as a rule devoted their time mainly to the practice of medicine—Hughes Bennett, *e.g.*, is oftener referred to as a physician than as a physiologist. A striking exception was Dr. Sharpey, an Edinburgh extramural teacher, who in 1836 was appointed Professor of Anatomy and

Physiology at University College, London. According to Lister and other distinguished pupils of Sharpey, all that was needed to make the physiology course at University College an ideal one was a laboratory for experimental physiology. But in the majority of the London schools, according to Huxley, physiology, even in 1870, was "taught as if it were a mere matter of books and hearsay." As an examiner, Huxley expected a real, precise, thorough, and practical knowledge of fundamentals, whereas most of even the best candidates gave him "a large, extensive, and inaccurate superstructure." Soon after Sharpey resigned in 1874, a course of experimental physiology was instituted by Michael Foster, and soon raised to a high standard by Burdon Sanderson. Soon after practical physiology courses were established, physiologists urged that the course of zoology for medical schools should be limited, or all but limited, to the study of the animals made use of in the physiological laboratory.

In course of time the type-system of teaching zoology was ridden to death; it led to cramming and to the production of biological parrots who believed that a knowledge of the structure of a few types entitled them to assume that they had a firm grasp of the great truths respecting animal life.

For centuries physicians had little or nothing to do with zoological science, and zoologists concerned themselves but little with medicine. But towards the close of last century, as the result of the combined efforts of physicians and biologists, many important and unexpected discoveries were made which served to establish for all time a close connection between zoology and medicine.

Dr. Ashworth, who will in future be mainly responsible for the invertebrate part of the course of zoology for medical students in Edinburgh University, has been good enough to prepare a statement indicating the part protozoa and other animals play in spreading disease. In this statement Dr. Ashworth says:

"Nowadays zoological work has assumed an importance in relation to human well-being that transcends anything which could have been thought possible twenty-five or thirty years ago. Few would then have ventured to predict, for example, that the study of the anatomy and stages of development of dipterous insects would prove to have an important bearing on medical work, but in these later years we have come to know that many of these insects exercise a profound influence on the health of the community, not only in tropical countries, but also, though to a less extent, in Britain. We have only to think of the mosquitoes as carriers of malaria, filaria, and yellow fever; phlebotomus as the carrier of three-day fever; tsetse flies and sleeping sickness; fleas and plague; flies as carriers of dysentery and typhoid; lice as carriers of typhus and relapsive fever, and possibly also of trench fever—a formidable list which shows at

once the importance of a knowledge of the habits and life-history of these insects.

"Moreover, it is to be remembered that in the case of some of the diseases mentioned the organism is either unknown, *e.g.* trench fever and yellow fever, or almost impossible to destroy after it has gained entry into the human body, *e.g.* sleeping sickness. Hence the measure of protection afforded depends entirely on a knowledge of the life-history and habits of the insect carrier, in which case the problem is in the domain of zoology—call it medical zoology if you like, but it is zoology more than medicine. The advances in our knowledge of such matters made possible the building of the Panama Canal and many other enterprises in the tropics which even a generation ago would have been impossible.

"In many other branches of medical work the influence of pure zoology is manifest—for instance the discovery of the spirochæte of syphilis and the recent rapid elucidation of bilharzia disease in Egypt, and observations on the life-history of the nematode ankylostoma and its mode of entry into man, not only by way of the mouth but through the skin, which have led to fruitful work on other worm parasites of man.

"Entomology, protozoology, and helminthology may now be regarded with bacteriology as well-established branches of preventive medicine, and practical sanitarians now take account of insects and certain worms and, as far as may be, devise measures for their reduction. The experience of recent years shows that the more we come to know of the structure, development, habits, and relations of animals—invertebrates as well as vertebrates—the more we realise at how many points they throw light on medical problems and in how many ways animals make contact with the lives of men."

I fear I have already trespassed too much on your time, but before sitting down I would like to say that our medical students should not only be able to read with profit the *Origin of Species*, but should have some acquaintance with the laws of heredity—know enough, for example, to realise the part played by the environment, that nothing can radically alter the composition of the germ-cells, and that, notwithstanding Lamarck and his followers, there is no clear evidence of the transmission of acquired somatic characters.

DISCUSSION.

Professor Robinson.—We have heard from Professor Balfour a very definite statement of opinion as to what should be done with botany in the medical curriculum. He thinks it should remain a university subject and not be taught in schools. I want to ask Professor Cossar Ewart whether he thinks zoology should be taught in schools.

Professor Ewart.—An ideal arrangement would be for the student to

take both botany and zoology before beginning the study of medicine, or, better still, for medical students to take a degree in Arts or Science, two of the subjects being botany and zoology. At Oxford and Cambridge medical students must obtain a degree in Arts before they can graduate in Medicine. As botany and zoology are taken as part of the Arts curriculum, the arrangement at these universities is an ideal one. Shortly after Lister returned to London he paid a visit to University College to see the museums then under my charge. During this visit Lister, talking about medical education, said he had come to the conclusion that from every point of view it was better for students not to begin the study of medicine until they were twenty. He also believed that at least a part of the course of zoology should be studied during the third year, that there were many subjects dealt with by the professor of zoology which had a direct bearing on medicine, subjects the value of which could not be appreciated before some progress had been made in the study of pathology.

With regard to my own subject, I wish to say that, for teaching zoology in Edinburgh, increased accommodation is required and a greater amount of time in which to do the work. When I came to Edinburgh all that was required was a course of lectures, and that continued for many years. To attempt to teach any such science by lectures alone is ridiculous. Before I came to Edinburgh a mere handful of men did any dissecting at all. In almost every other college in the country zoology occupies more time than it does here. Our students have no time to make drawings of their dissections, and many dissections are of little use unless drawings are made. The course we gave last winter was the best given since I came here. The work was spread over three days a week during five months, instead of being crammed into ten weeks. The students had thus time to think over their work. Not only had we more time, but the most of the lectures on invertebrates were given by Dr. Ashworth. The result was entirely satisfactory, and I am glad to say that in future Dr. Ashworth will give in summer as well as in winter the lectures dealing with the subjects in which he is an expert. In the case of medical students not intending to take a degree in Arts or Science there ought to be a year set apart for the study of two or three of the subjects of the First Professional before the study of the Second Professional subjects begins.

Dr. J. H. Ashworth.—Professor Ewart and I are emphatically of opinion that zoology for medical students should be taught in the university. Reasons already given by Professor Balfour in support of his opinion that botany should be taught in the university apply equally to zoology, and to these may be added the further advantage of continual contact between the teachers of zoology and those of the later subjects of the curriculum.

We consider that it would be better for the student to acquire a general knowledge of the structure of animals, as he does in the lectures on zoology, and, in the course of practical zoology, a personal acquaintance with the main structural features of a series of selected animals, including at least two relatively simple vertebrates, before entering upon the minutiæ of human anatomy. Therefore we hold that the student should finish his course of zoology before beginning human anatomy.

We are further of opinion that certain changes in the nature and scope of the course in zoology would be beneficial. We should like to be able to

introduce into the practical course at no distant date more microscopic work, especially upon living objects, *e.g.* protozoa, segmenting eggs, chick embryos. The study of living organisms exerts a strong stimulus on the powers of observation and constructive imagination, and a well-considered course of practical zoology, which includes carefully chosen living examples, can arouse and foster these two powers in the young student better than anything else I know. Certain prepared objects and sections should also be examined, including material showing nuclei at rest and in division, after a study of which the student would be able to understand more clearly the discussions in the lecture course on some of the interesting problems connected with the chromosomes.

The chief aim of the lecture course in zoology should be to put before the student the main facts in regard to the structure, origin, and development, the habits and the adaptations to environment of a limited number of carefully selected examples as a basis of knowledge of the groups to which they respectively belong, the interesting features of the group being dealt with in broader fashion. The course should also include an elementary introduction to the study of heredity. These are the problems which are going to engage the medical student in regard to a special example, and if a lively interest can be aroused in them during the first year the student will be a better medical man.

The practical work should, as I comprehend it, be directed with the aim of giving opportunity for personal verification of the main structural features of a series of selected examples.

Owing to the great value of properly conducted practical work, I would urge that this side of our work be extended if additional time can possibly be obtained.

There is another change in regard to the teaching of a branch of zoology which has been in my mind for two or three years, and I am glad to find myself in agreement in regard to this with Professor Ewart and Professor Lorrain Smith. I suggest that a short course of parasitology in the third year would be advantageous. At present a certain amount of time is set aside in the third year for the study of parasites, the eggs of parasitic worms, etc., and my suggestion is that this work be remodelled on a broader basis. Parasitology has during recent years become so specialised that a pathologist or a bacteriologist can scarcely be expected to keep pace with its rapid advances; it is, in fact, medical zoology. For more than twenty years a course of medical zoology has been given by Professor Blanchard in the faculty of medicine in Paris during the third year, by which time the student can properly appreciate the importance of the factors in the life-history of the parasites and the effects on the human host. A similar arrangement in this university would prove beneficial, and I venture to put it forward for consideration.

(On being asked to deal definitely with the amount of time required for the suggested courses in zoology.)

I cannot say at the moment exactly how much time would be necessary for the proposed course of parasitology in the third year, but probably fifteen hours would go far towards dealing with the main points.

In regard to the first-year course I do not suggest any additional time for lectures. We can probably give the necessary instruction on the structure, development, and adaptations of animals in the present number of lecture

hours, but the practical work should, if possible, be increased to half as much again, *i.e.* to seventy-five hours.

It has been suggested that the practical bearing of zoology on medicine should be pointed out to the student, but this is now so obvious that it is scarcely necessary to draw attention to it. Let me outline the first-year student's work on the invertebrates, with which I am specially concerned. Beginning with the protozoa in the lectures, I give an account of the structure, physiology, and life-cycle of amœba ; I then describe entamœba, especially *entamœba histolytica*—the organism of amœbic dysentery—its chief characters and life-history, and how it is acquired by man. A free-living flagellate and a trypanosome and the part played by tsetse flies in the transmission of the latter are studied. Of the ciliate protozoa, paramæcium is selected for description. This organism has been investigated with extraordinary care ; it has, for instance, been bred through more than five thousand generations by one observer, and we know intimately its life-history and its nuclear phenomena. Paramæcium is useful to the medical student, because it enables him to appreciate, by the study of a concrete example, several matters having a wide significance, *e.g.* the interchange of nuclei in conjugation, the subsequent reorganisation, and the influence of environment. The last group of protozoa—the sporozoa—is studied by means of two examples—(1) monocystis, parasitic in the earthworm, chosen because it is easy to obtain alive and on account of its large size ; and (2) the organisms of malaria, in regard to which the life-history and the part played by mosquitoes are made clear. The two-layered animals—hydra and its relatives—which are next considered, are useful as representing a stage in the evolution of higher animals and as a clear-cut example of the functions of the two cell-layers. Passing to a segmented worm, as an example of a three-layered animal, special attention is directed to the segmented mesoblast and to the occurrence of metameric segmentation in higher animals, up to man himself. The crayfish is used chiefly for the study of its external features, because of the striking manner in which this animal illustrates the adaptation and modification of homologous appendages in correlation with the discharge of various functions. The crayfish also affords a good example of the grouping of segments into regions and of "cephalisation." The nervous system provides an opportunity for discussing the evidences of the affinities of crustacea with segmented worms. A wide contrast from these is afforded by the snail, which is taken as an example of the mollusca. The general features of the groups to which these selected examples belong are given and reference is made to those members of the group which are well known or have any special relation to man. In addition, three lectures are devoted to parasitic worms, particular attention being given to their life-histories, their mode of entry into man, and to those means of prevention which are indicated by a knowledge of their biology.

In the practical course two segmented worms, a crayfish, and a snail are dissected ; the other selected examples are examined under the microscope, alive, as far as possible, in a series of demonstrations. If additional time can be given to practical zoology the whole course, but especially the microscopic work, will be remodelled as soon as conditions make this possible.

Dr. Rainy.—The position is a very clear one : the biological sciences of botany and zoology must, in a certain sense, be preliminary to medicine, and yet it has been put before us strongly that they should not be taken up

at too early a stage of intellectual development. That, in fact, we cannot substitute school teaching for university teaching, and therefore if we are to retain these subjects in our curriculum we have to find an adequate place for them. We must gain longer time for the medical curriculum, even if it means an extra year. We are all strongly in favour of more practical work and of securing adequate time for such fundamental subjects as have been represented to-night. In that extra year we should also have to make provision for chemistry and physics.

Dr. Logan Turner.—One has always felt that the preliminary scientific subjects were an essential part of any university training in medicine. I cannot see the advantage that would come to the student by being taught these subjects in school. If the student were to start out on his medical curriculum with anatomy and physiology, he would attack these subjects with much less power than if he had already had some preliminary training in botany and zoology. In those classes he is taught to observe, and it is there that he learns a certain amount of independent thought.

Mr. Miles.—Now that we have heard the views expressed by the heads of the four scientific departments, I confess that I feel more than ever convinced that their subjects must remain part of the university teaching and not be relegated to the schools. The course of zoology has recently been spread over six months instead of three, and we are told that the students have done much better. If we could, without giving the professors of the early subjects any more hours, spread the existing hours over a longer period, I wonder if the students would carry away more than they do at present. Would the professors, by extending the period of study over, say, fifteen months, expect any better results?

How could we better co-ordinate zoology and botany with the earlier subjects in our curriculum? We have seen how we may, in certain departments of chemistry, co-operate with the professor in the later stages of the student's course. Could we in the same way secure from Professor Balfour some assistance as an introduction to bacteriology, or from Professor Cossar Ewart as an introduction to parasitology—say in the fourth or fifth year?

We cannot separate the question of examinations from that of teaching. We must find out how we can best test the student as he goes through his course, and not only at the end of it, and the appearance he makes during his course must count at the end as part of his pass marks.

Dr. J. S. Fraser asked the professors at what age they thought the medical student should begin his course. He was in favour of retaining the scientific subjects in the university curriculum.

Dr. Dingwall Fordyce. — It is important that these fundamental subjects should come at the beginning of the medical course, and we probably all agree that they are better taught after school has been left. In his last years at school a boy should not be starting the serious business of life ; this should begin with the university. As regards a compulsory degree in either Science or Arts before the medical student starts his course, all who have been associated with universities where such a degree is compulsory must have recognised how different the students were in the later years of their medical curriculum ; if the student has an accurate and thorough teaching in his fundamental subjects he will learn much more easily in the later years.

Professor Robinson.—As regards increasing the length of the curriculum from the parent's point of view, it costs, at the outside, to produce a medical student with a degree for the whole five years, about £900, including everything. It is about as good an investment as any father can make for his son, as he can get a living directly he is qualified.

It has been pointed out that in England they get a longer time for botany and zoology, but they take it off the final years.

Dr. Traquair.—I understand that the course of zoology is the same for students of Arts, Science, and Medicine. Is there any possibility, without deducting anything from the educational side of his studies in the preliminary sciences, of providing a selective course specially adapted to the student who is ultimately going to become a medical practitioner, giving special attention, for example, to such subjects as parasitology, at the expense of the kind of course that a Science or Arts student would be taking?

Mr. John Fraser.—We ought to look at this subject more from the point of view of the student, because, after all, it is the student whom this matter is going to affect. In these preliminary subjects it should be made clear to him why he is being taught zoology and botany from the point of view of his after-studies. Many students are antagonistic to botany and zoology when they begin because they do not understand why they are being taught.

Dr. James Miller.—The medical student first wakes up when he comes in contact with the patient. A medical student cannot too early come in contact with the surgical out-patients. Looking back to the time of Mr. Joseph Bell and Mr. John Duncan, one remembers that when they were taking their out-patients they aroused in the students an interest in the practical clinical side of surgery that never died. Professor Bayley Balfour said that he would like his students to know something of chemistry and physics when they came to him. Is that not an argument that the boy at school should have some teaching in physics and chemistry—that he should know what every educated man ought to know—something about heat and light, and something about the general broad outlines of Nature?

Professor Lorrain Smith.—The subject has been dealt with practically on the conception which Professor Bayley Balfour introduced, *i.e.* that you are changing the whole mental outlook and attitude of a boy who comes from school to the university, and that he is passing from study under authority to the study of evidence. We are attempting to define what we are aiming at with the student when we get him into the new sphere; some little preliminary acquaintance with the general principles of chemistry and physics may be good, but this should be very simple—the kind of science which lends itself to school teaching. If you pass on a little you get into a sphere which it would be very difficult for the schools to qualify themselves to occupy. We are now setting out to study more clearly what I may call the psychological position of the student when he comes to the university. What should be his first subject of study? After what Professor Cossar Ewart, Professor Bayley Balfour, and Dr. Ashworth have told us it would be difficult to imagine anything better than the study of organic life, by the methods described, as an introduction to the study of medicine. The living organism in its evolution is in itself one of the most fascinating problems which the

human mind can take up, and I think if we fail to interest our students in this they must be, mentally speaking, extremely pachydermatous.

It has been suggested that instead of five years the student may have to spend six years over his course. We in Edinburgh have kept the fifth year entirely free from systematic teaching. In some other schools they have not succeeded in doing that. I think that we will find that after five years a man begins to get stale as a student. We are sometimes disappointed in the men who have taken an Arts or Science degree preliminary to medicine. I think the reason is that they want a change of pasture from being undergraduates ; if we keep the man too long in the same method of study, going to lectures and being taught to observe, he gets tired, and it would be much better if he could then pass to post-graduate methods. Is it therefore wise in the interests of the student to extend the course further than five years?

The contribution to-night has taken us forward a very definite step in dealing with the curriculum, and will be very helpful in the discussion of the further subjects. The attitude of the student at present is radically unsound. He wants to get away from the teacher and commit to memory the maximum of printed matter. He thinks the more he can commit to memory the better it will pay in the examinations. I was hoping that Dr. Ashworth would develop his scheme of practical work to the point that he would be able to abolish the examination. So far as he abolishes lectures he is going in that direction. Could he not arrange the practical work so that examinations would become a superfluity? They have gone a considerable distance in that direction in the Arts Faculty. In certain subjects term work counts in the degree examinations. We have the General Medical Council watching over us, and no doubt there will be great difficulties put in the way of abolishing examinations, but I think it may be managed when we can show properly organised courses of study and proper methods of carrying them out. Thus I hope we shall study the psychology of the student, and try to get rid of this nightmare of examinations.

Professor Bayley Balfour said in reply.—I thoroughly agree with what Professor Lorrain Smith has said about the examinations. I confess I have tried to do without them in my course as much as possible. I tell the men at the beginning of their practical work that I shall watch them individually throughout the session, and if they do their work thoroughly well they need have practically no fear when they come to the examination room. I find this gives most excellent results. I should have very little to complain about in their work if it were not for anatomy in the afternoon!

I find that the men who have taken their M.A. beforehand are much more easily taught ; they get a grip of the subject much better than the young men. Boys who come up at seventeen are far too young. I find them at eighteen or nineteen much better. I am delighted to find that there is such general sympathy with the foundation sciences in the club to-night. In a way it comes as a surprise, because not so very long ago the talk of medical education was always in the direction of abolishing the biological sciences from the curriculum.

As to co-ordination of the subjects, I think that, so far as my subject is concerned, it must come through these equipment subjects. I can only indicate the elementary work so far, and the special forms in which my subject touches upon medicine should be dealt with by the special lecturers in the later periods of the men's course.

PROFESSOR COSSAR EWART said in reply.—It has been asked whether it would be an advantage to delay the examination in zoology for a number of months after attending the course. The written examination might be delayed, but it certainly would not be an advantage to delay the practical part of the examination. If a student has been dissecting for three or more months it is only fair to give him an opportunity of taking his practical examination at the end of the course. His work during the term ought, as a rule, to show whether he should get through or not ; a good record should count for something in the professional examination.

With regard to asking for more hours, it is only fair to the men. If a man, *e.g.*, makes a dissection of the nervous system of the skate, but has no time to make drawings, he will often profit little. To dissect without making drawings is often a waste of time.

In fixing five years for the curriculum we are only fixing a minimum. One year of the allotted time might be regarded as not for medicine at all. To hurry a man on, as Lister said, is not economic.

RECENT ADVANCES IN MEDICAL SCIENCE.

LARYNGOLOGY.

UNDER THE CHARGE OF

A. LOGAN TURNER, M.D., F.R.C.S.E., AND J. S. FRASER, M.B., F.R.C.S.E.

TONSILS AND ADENOIDS.

THE indications for removal of tonsils and adenoids, the methods of operating, the post-operative complications and the results obtained have been keenly discussed during recent years, especially in the United States. The following abstract is largely taken from a paper by Crowe, Watkins, and Rothholtz. These writers state that the reorganisation of the Nose, Throat, and Ear Department of the Johns Hopkins Hospital in 1911, on what was practically a full-time basis, has rendered it possible to make a more careful general physical examination of the patients before operation, to carry out the operative procedures under the best conditions, to make histological examinations of the tissues removed at operation in every case, and to establish a system for following up the more interesting cases after their discharge from the hospital. The greatest benefit derived from this full-time arrangement, however, was the spirit of co-operation between the laryngological and other departments. The post-operative data were obtained partly through the patient's doctor, partly by letters from the patients, but chiefly by a special social service nurse who visited the patients at their own homes. The writers intend to re-examine their interesting cases and to report again on their condition after five years.

Anatomy.—According to Platte the tonsil is the largest lymph

nodule of the respiratory and alimentary tracts. It is an encapsulated organ, and possesses numerous irregular crypts which extend through the gland to the capsule. The inner or exposed surface, including the crypts, is covered with mucous membrane, while the outer or hidden surface is enveloped by a fibrous capsule. The tonsillar mass is made up of lymphoid tissue, which surrounds the crypts and contains germinal centres for the production of leucocytes. These centres are particularly active up to the time of puberty.

The plica triangularis is a fold of mucous membrane which is attached above to the superior border of the posterior pillar; anteriorly it becomes continuous with the anterior pillar, while below it is inserted into the lateral aspect of the base of the tongue. Embryologically and pathologically the plica has its analogy in the prepuce. The tonsil corresponds to the glans and a submerged tonsil to a case of phymosis. According to Murphy the plica should have receded at birth, so that it does not interfere with the movements and drainage of the tonsil. The plica varies in size from an inconspicuous border along the anterior pillar to a fold which covers the greater part of the tonsillar fossa, as in early fœtal life. The crypts of the tonsil are drained at frequent intervals because the contraction of the superior constrictor and palatal muscles during the act of swallowing exerts pressure on the tonsil. When the orifices of the crypts are partially occluded, this pressure tends to force organisms into the parenchyma of the tonsil. In those cases, however, in which the plica does not normally recede, it is pulled to the inner side of the tonsil when the tongue moves backwards during deglutition instead of passing to the outer side of the tonsil as it should do. This prevents the normal draining of the crypts and favours retention. There is apparently no relation between the growth of the tonsil and the size of the plica. A large tonsil may have a large plica or one that is scarcely visible. A small tonsil may be almost entirely covered by a large plica.

The child is born with a well-developed tonsil, and the normal process is one of hypertrophy up till the age of 5 or 6 years, followed by retrogression. Atrophy is often complete at the age of 18 years, the organ then consisting of fibrous tissue with an inconspicuous amount of lymphoid material. On the other hand, we often find tonsils at the age of 50 showing little evidence of retrogression with marked retention in the crypts.

The efferent lymphatics pass to the tonsillar gland, which lies just beneath the anterior border of the sterno-mastoid muscle where the posterior belly of the digastric crosses the internal jugular vein. When enlarged, this gland is dislocated outwards and forwards and presents at the angle of the lower jaw. Platte states that a lymphatic connection between the tonsil and the apical pleura has been definitely established. This view, however, is by no means universally accepted.

Function of the Tonsil.—(1) It has been stated that the tonsils elaborate an internal secretion similar to that of the suprarenal glands. Tonsillectomy, however, is not associated with any symptoms which might be attributed to the loss of an internal secretion. Further, tonsils have been fed to animals (rats) over considerable periods without producing any obvious changes. (2) The tonsils are often regarded as organs of protection against bacterial invasion. This is probably quite correct, but the fact remains that they frequently fail to limit infections to their own tissues or to prevent general infection.

Henke states that there has been much exaggeration regarding the frequency with which the tonsils form the portal of entry for many general diseases. He does not believe that the tonsil absorbs from its epithelial surface, and holds that the lymph current is in the opposite direction. He considers that tonsillitis is due to infection reaching the tonsil from the lower part of the nasal cavity. He has injected the nasal mucosa with solid particles in suspension and has found a direct lymphatic communication between the nose and the tonsils. The function of the tonsil is therefore comparable with that of the ordinary lymph glands. When the tonsil becomes a "choked filter" it is a constant source of danger to the body as a whole. (3) It has been asserted that the tonsils act as eliminating organs during the common acute infections and that tonsillitis during such infections is due to the effort to get rid of the offending organism. (4) The most generally accepted view is that the tonsils are the vaccine laboratories of Nature. The crypts may be regarded as so many culture tubes in which bacterial growth occurs and in which toxins are generated. These toxins are absorbed in sufficient doses to produce the necessary antibodies to immunise the individual. It must, however, be admitted that the histological structure of the tonsil is identical with that of other lymphoid nodules and that the function of all of these is very much the same.

Pathology.—The bacteriological examination of seventy-two normal cases showed the presence of a streptococcus in fifty, the pneumococcus in fourteen, a staphylococcus in twenty, the micrococcus catarrhalis in twelve, the diphtheria bacillus in sixteen, the diplococcus mucosus capsulatus in four, and the influenza bacillus in five. Pybus believes that infection of the tonsil comes more often from the free surface than from the nose. Poynton and Paine have shown that in a patient suffering from chronic endocarditis, organisms can be isolated from the tonsil after an attack of tonsillitis—organisms which show the usual characters of the streptococcus of rheumatism. On inoculation into a rabbit endocarditis was produced.

Beck believes that foci of infection are more frequently found in the tonsils than in all other organs. A septic tonsil may be normal in size or even atrophied and yet prove to be the seat of retention.

The most common constitutional symptoms of focal infection is indisposition or malaise, often to the extent of great fatigue, due apparently to toxic absorption. Such cases experience complete relief from removal of the tonsils.

Wood has found that organisms may gain entrance to the parenchyma of the tonsil by passing through the unaltered epithelium of the crypts. According to Crowe, Watkins, and Rothholtz, it is probable that acute tonsillitis usually begins as a focal abscess or abscesses in partially obstructed crypts. It may often be aborted during the early stage by irrigation of the infected crypts with sterile salt solution. These writers also hold that during the early stage of an acute tonsillitis there is a general bacteremia. If the organism be of low virulence, or if there be a sufficient degree of immunity, it is quickly killed off. If, on the other hand, the organism is one of the streptococci, especially the streptococcus viridans, metastatic infections may occur. Pneumococci and other pyogenic cocci may also give rise to endocarditis. Patients with tonsils that have been damaged by previous infections or partial operative procedures (tonsillotomy) are more likely to have some general disorder as the result of acute tonsillitis than those with a first infection of previously normal tonsils. The writers regard the *enlargement of the neighbouring lymph glands as one of the most important points in determining whether or not there is a chronic infection of the tonsil.* It is probable that the joint, renal, muscular, and valvular lesions secondary to a focal infection are due to infected thrombi. Crowe, Watkins, and Rothholtz found that joint or peri-articular suppuration occurs in about 50 per cent. of animals injected with streptococci obtained from a scarlatinal sore throat or an accessory nasal sinus infection. The synovial membrane of a rabbit's joint may be sensitised by (1) repeated intravenous injections of streptococci of attenuated virulence, or (2) by injecting into the joint cavity a suspension of killed streptococci. Intravenous injections of minute doses of living streptococci of the same strain will then give rise to arthritis in the joint previously sensitised. This may explain the frequent recurrence of arthritis after an initial attack of rheumatic fever and also the more chronic forms of arthritis associated with a small focus of infection in a tooth, tonsil, or nasal accessory sinus. A thorough removal of the primary focus is necessary in such cases, but it must be remembered that infection of the adjoining lymph glands may remain even after the original focus in the tonsil has been completely removed.

Thiesen reports six cases in which thyroiditis occurred directly after an attack of tonsillitis. Two of the patients afterwards developed diffuse goitres. The patients were all girls or young women.

Indications for Operation.—Layton holds that, before advising operation, we must eliminate two fallacies—(1) we must not come to a conclusion just after an acute attack of coryza or tonsillitis; (2) we must

remove any other source of septic infection in the mouth. Layton found that many tonsil cases which had to wait a considerable time before operation did not require interference when they were admitted. In the interval they had had their teeth attended to and had been taught breathing exercises.

Platte remarks that hypertrophy of the tonsil is a purely relative term, for there is no sharp dividing line between normal and hypertrophied tonsils. In the child, hypertrophy may be only a physiological process, whereas in the adult it is due to connective tissue proliferation and is pathological. Tonsils may be very misleading in appearance. The buried tonsil (a large tonsil in a deep sinus) is the largest type of tonsil and yet it may not show itself beyond the pillars. A small tonsil in a shallow sinus, on the other hand, may appear very prominent. Hence prominence and hypertrophy are not necessarily synonymous terms. Tonsils pronounced large before operation, because they are prominent, are often found to be smaller when removed than buried tonsils, which, on account of their submerged condition, did not attract attention. The very worst conditions as regards retention may exist in the small buried tonsil.

Crowe, Watkins, and Rothholtz give the following indications for tonsillectomy:—A. *Disorders of the Upper Air-Passages.*—(1) Enlargement of the tonsils, causing dysphagia or difficulty in speaking or breathing. (2) Frequent tonsillitis or quinsy. (3) Chronic laryngitis. (4) Catarrhal or suppurative otitis media or Eustachian obstruction. (5) Chronic diphtheria carriers. (6) Reflex neuroses in children, *e.g.* asthma, eneuresis nocturna, convulsive seizures. (7) New growths.

B. *Affections of the Cervical Glands.*—(1) Enlargement of the tonsillar glands. (2) Tuberculous cervical adenitis.

C. *General Systemic Disorders* secondary to a focus of infection in the tonsil.—(1) Infectious arthritis. (2) Myalgia or myositis. (3) Early glomerulo-nephritis. (4) Neurasthenia (?) (5) Some cases of iritis. (6) Rare cases with septic temperature, leucocytosis, muscular pains, and enlarged tonsils.

D. *As a Prophylactic Measure.*—(1) In chorea, rheumatic fever, and heart lesions (?) (2) In chronic nephritis and arteriosclerosis with a history of repeated attacks of tonsillitis (?)

In Baltimore about 25 per cent. of the children visiting the various out-patient departments have some definite indication for the removal of adenoids, the most frequent being attacks of otitis media.

Contra-Indications.—(1) The tonsils should not be removed during an attack of acute tonsillitis. Cases have been reported in which a cerebral abscess followed a tonsillectomy while the tonsils were inflamed. (2) M'Kenzie states that in acute middle-ear suppuration we should not operate on the throat till the acute symptoms have subsided. (3) Rheumatoid arthritis. (4) The acute stage of chorea,

rheumatic fever, or endocarditis. (5) Pulmonary tuberculosis. (6) Tonsillectomy should not be performed on any patient with an elevated temperature, as the child may be in the incubation stage of an infectious fever. (7) Operation should not be performed upon diabetics, as these patients are bad subjects and sepsis is likely to follow. (8) Moore holds that it is unjustifiable to operate for the relief of arteriosclerosis. (9) The tonsils should not be removed merely because an operation for adenoids is called for. (10) Hæmophilia.

Singers.—The advisability of removing the tonsils in singers has been frequently discussed. Vorhees has questioned a large number of physicians and singing teachers on the subject and has come to the following conclusions :—(1) In the hands of skilled operators there need be no special fear of bad results following enucleation of the tonsils. Bad results are most often due to cicatricial contraction, the result of careless dissection or neglect of after-treatment. Loss of singing voice occurs very rarely after tonsillectomy. Most cases show an increased range of from one half to a full tone. Post-operative care is of special importance. The patient should be seen daily until full healing occurs.

There is, especially in the United States, a marked reaction against indiscriminate removal of the tonsils. There is also a growing appreciation of the fact that operations are occasionally attended by danger and followed by unpleasant symptoms. Comroe expresses the hope that many tonsils may be rescued from unnecessary and undeserved slaughter. He recalls the successful escape from a somewhat similar fate of the ovary, the appendix, and the inferior turbinal. In 1912 there were in Philadelphia 37,000 recommendations to parents that their children's tonsils receive immediate attention. In New York, during the same year, 825,000 school children were under medical supervision, and 30 per cent. of the cases examined had hypertrophied tonsils. The department desired to fix a standard as to when operation should be recommended, and sent a letter to a number of specialists inquiring as to the exact indications for operation. Comroe says that no two of these specialists agreed. Richardson takes the same line as Comroe, and states that it has been thoroughly ingrained during the past decade that the tonsils are the portal of systemic infection. The small-sized, buried tonsils, we are told, are the greatest offenders. It has even been stated that no adult should possess tonsils, nor even the site from which the tonsils had been removed. Even the layman, nowadays, holds himself competent to judge of the advisability of operation, and frequently says he has "come to have his tonsils removed." Independent of the tonsils, there are many points which may be the origin of general infections. Richardson objects to the removal of tonsils which show no macroscopic evidence of disease. That the possessor of this type of tonsil may be the subject of an

infection that cannot be accounted for does not justify the removal of the tonsil. Numerous instances can be given of acute and chronic rheumatism and of rheumatoid arthritis where tonsillar enucleation has been followed by total failure to obtain relief. Some practitioners send patients with the statement that they have expressed pus from the tonsil; but in the great majority of cases Richardson fails to confirm their findings. On the other hand, he meets with many who come to him in the hope of being relieved of the faucial dryness due to tonsillectomy.

Diagnosis.—All laryngologists have felt the difficulty of determining in a given case whether (1) the tonsils are healthy or diseased; (2) whether recovery may be expected from conservative measures; and (3) whether enucleation is called for. For these reasons they will be disposed to welcome the work of Thomas R. French, which promises help in these directions. French's new diagnostic instrument—the tonsilloscope—consists of two parts—(1) a tubular speculum with lenses or tonsil microscope, and (2) a slender lamp which can be placed behind, below, or above the tonsil. The distal end of the microscope is bevelled and has an aperture one-quarter of an inch in diameter. The lamp is placed in position behind the tonsil and firmly pressed outwards, while the distal end of the microscope is applied to the tonsil. When the light is turned on the tonsil is transilluminated. The normal tonsil is relatively translucent, of a warm amber colour, and permits a considerable insight into its contents. The slightly diseased tonsil is pink amber and less translucent. Small superficial abscesses (retention in the crypts (?)) appear as dark discs. When there is a considerable amount of general disease the appearance of the tonsil on transillumination is of a much deeper pink colour. As French's work is of quite recent date, no independent reports have appeared up to the present time confirming or refuting his views as to the value of the tonsilloscope.

Preparation.—Moore holds that tonsillectomies are major operations, and that they should be carried out in hospital by an experienced specialist. Three days in hospital should be the shortest stay demanded. Hospital interns should be instructed in the control of post-operative hæmorrhage. All patients and parents should be informed that there are possible dangers and complications following removal of the tonsils. The surgeon should make sure before operation that there has been no recent case of illness in the house.

M'Kenzie advises that we should make sure before operation that the mouth is reasonably clean. Carious teeth should be removed and the mouth treated with some simple antiseptic wash. The heart and lungs should be examined and the urine tested. The question of hæmophilia should be inquired into, and, if there is any suspicion, the coagulation time of the blood should be ascertained. Kahn and

Gordon state that calcium salts have been used with indifferent success as a means of controlling the hæmorrhage after operation. Blood-serum gives reliable results but may produce anaphylaxis. These writers recommend pituitary extract, and state that the coagulation time is reduced to one-half or one-third of the normal.

If an anæsthetic is to be given the usual preparation is, of course, called for. Patients should be operated on in the morning and should remain in bed for the rest of the day at least.

Anæsthesia—General.—In infants under one year M'Kenzie holds that no anæsthetic is necessary for the removal of adenoids. From the second year onwards till puberty he uses ethyl chloride. After puberty he advises nitrous oxide with or without ether for adenoid cases, but states that chloroform is necessary for the removal of tonsils in adults, *i.e.* if a general anæsthetic is required at all. In America and in many cliniques in this country ether is used instead of chloroform.

Crowe, Watkins, and Rothholtz advise general anæsthesia (ether) in every case of tonsillectomy.

Local.—Burns states that a 2 per cent. solution of quinine and urea is the best local anæsthetic; 30 to 40 minims are usually sufficient. It requires five to six minutes for the infiltration to produce marked anæsthesia. Five points of injection on either side are required, while 3 minims are sufficient at each point. No alarming symptoms are caused if any of the solution is accidentally swallowed. The tissues are completely anæsthetised, no pain being produced by such operative procedures as pulling the tonsil forward from its attachment or the separation of adhesions low down. Anæsthesia usually lasts five to seven hours. Burns has not encountered in a single case the disagreeable phenomena associated with cocaine and other toxic anæsthetics. Another noticeable advantage is the absence of hæmorrhage, either primary or secondary, due to the injection producing a fibrinous induration in the tissue surrounding the blood-vessels. The induration lasts many days. The great majority of patients expressed themselves as suffering no pain whatever. There is marked diminution of after-pain and discomfort. The solution may be sterilised by heat without damage to its anæsthetic properties.

Ersner employs normal saline solution instead of 0·5 per cent. cocaine or 1 per cent. novocaine for submucous infiltration. The anterior and posterior pillars are first swabbed with 10 per cent. cocaine and a little later 3 drms. of normal saline are injected around each tonsil in the following situations:—Superior and inferior poles, one injection each; anterior and posterior pillars, two injections each. When infiltration is perfect the tonsil bulges out and becomes pale owing to retro-tonsillar pressure. If the patient's heart is in good condition 2 minims of adrenalin are added to the solution for each tonsil. Ersner claims that by this method post-operative sloughing is

avoided, healing is promoted, and most patients are able to take food without difficulty within twenty-four hours of operation.

Surgery.—The result we should aim at is a complete removal or enucleation of the tonsils without damage to the surrounding tissues. It matters little whether one (1) uses a guillotine, or (2) dissects out the tonsil with the aid of a knife or scissors and snare (with or without finger dissection), so long as the results are good.

In children, enucleation with the guillotine is easy once the knack is acquired (M'Kenzie). Enucleation removes the whole tonsil yet spares the faucial pillars and part of the capsule, so that the fossa, or bed of the tonsil, is not obliterated by scar tissue, and the natural formation of the throat is preserved. The knack of guillotine enucleation lies in adjusting the ring of the instrument accurately round the tonsil from below and behind, and in pressing the tonsil firmly forwards and upwards till the soft palate and anterior pillar bulge markedly. The thumb or index finger of the surgeon's free hand is then pressed on this bulging till he feels the tonsil turn itself inside out through the ring of the instrument. The blade is then pressed home and the tonsil removed on the posterior surface of the instrument. According to M'Kenzie there are two parts of the tonsil which the blade is liable to slice—the upper and the lower poles. The deep or attached surface of the tonsil should always be examined immediately to make sure that it is entire. To do this the tonsil usually has to be inverted, *i.e.* returned to the condition in which it exists as it lies on the tonsil fossa. If the tonsil is not entire the guillotine should be reinserted and the remaining portion removed.

In adults, in many cases, the tonsils are tough and adherent. In such cases local anæsthesia is usually employed and the tonsils removed by dissection.

Crowe, Watkins, and Rothholtz prefer the patient in the lying position with the head hanging, and advise that the nasopharynx be plugged with gauze. The operator wears an electric head-light. The gag and tongue depressor are inserted. One tonsil is seized with a tenaculum and the upper pole pulled towards the median line. An incision is then made through the mucous membrane just internal to the anterior pillar. A retractor is now inserted. The tonsil is removed by sharp dissection with scissors, keeping as close as possible to the capsule. Every bleeding vessel is clamped and, at the end of the operation, ligatured with black silk and a curved needle.

Circumcision of the Tonsil.—Murphy is convinced that more than 90 per cent. of the tonsillectomies performed to-day will be abandoned for a more scientific, practical, and safe method, namely, circumcision of the tonsil. This operation can be performed in the consulting-room with the aid of local anæsthesia. The plica is first separated from the anterior pillar by means of an elongated U-shaped punch, which must

cut to the bottom of the anterior fossa, *i.e.* the space between the anterior pillar and the tonsil. A blunt hook should be used to make sure that a crypt has not been opened instead of the anterior fossa. The plica should then be removed with the Hartmann tonsil punch for about a quarter of an inch below the bottom of the anterior fossa, and also along the posterior edge of the incision. When the operation is complete the blunt probe should pass freely over the tonsil. At the end of a week the incision should be inspected for adhesions, which, if present, are easily broken down with a blunt probe. After operation Murphy applies 2 per cent. iodine in glycerine to the raw surface. Murphy compares his operation to circumcision, and claims that it removes a foreskin (the plica triangularis) which obstructs the proper drainage of the tonsillar spaces.

Recent reports of a large number of cases of pneumonia following tonsillectomy under general anæsthesia have stimulated Israel to devise an instrument to aspirate the blood which may find its way into the lower air-passages. The instrument consists of a bent Y-shaped metal tube which is so curved that it conforms to the contour of the nasal dorsum in order that it may lie flat and out of the way of the anæsthetist and operator. To the end of each of the prongs of the Y is attached a piece of rubber-tubing about 5 ins. in length, and with a number of small perforations at the distal end. One tube is inserted into each nostril and passes along the floor of the nose, and then through the nasopharynx until it extends about one half inch below the uvula. To the single barrel of the Y metal tube a rubber tube connects with the suction apparatus.

Complications — Hæmorrhage. — M'Kenzie holds that tonsillar hæmorrhage is almost always primary. Before the patient leaves the table the surgeon ought to make sure that the bleeding has actually stopped. For this purpose the throat should be swabbed out and inspected. When the patient has returned to bed he should not be allowed to lie on his back, but should be placed semi-prone on his side, with his face turned half down and with a basin under the mouth and nose. In this position the blood runs out of the nose or mouth instead of being swallowed. The case should always be visited by the surgeon himself not later than three hours after operation. All vomited material must be kept and shown. M'Kenzie gives the following directions for the examination of the throat in a case of post-operative bleeding:—A Doyen gag should be inserted and a good light reflected from a forehead mirror on to the tonsil region. If one tonsil fossa is seen to be occupied by a large clot, that fossa is the culprit. If in doubt whether the hæmorrhage is coming from the tonsil fossa or from the adenoid area, the patient's head should be held face downwards, for in that position blood from the adenoids emerges at the nose while hæmorrhage from the tonsil comes from the mouth. If the case is one

of tonsil hæmorrhage the blood-clot must be cleared out by means of a sponge on a sponge-holder. The anterior pillar must then be held aside with a hook so that its posterior surface may be inspected. This is the favourite site for a tonsil spouter. If the bleeding point can be seen, it must be picked up with pressure forceps. The fossa should now be sponged out again and other bleeding points looked for. When all have been seized, ligatures should be applied if possible. If ligation is impossible the gag should be removed and the forceps left in position for twelve hours. (Instead of attempting to catch and ligature the bleeding vessels the surgeon may apply a sponge — wrung out of peroxide of hydrogen and held in a sponge-holder—to the bleeding tonsil fossa. Firm pressure for from ten to twenty minutes is usually sufficient to stop the hæmorrhage.) Watson Williams' tonsil clamp is useful. The two ends of the clamp are padded with gauze, and the end meant for insertion into the tonsil fossa soaked in peroxide of hydrogen. This end is then placed in the bleeding tonsil fossa, while the other end lies externally over the angle of the lower jaw. A hypodermic injection of morphia is a useful adjunct.

Hæmorrhage from the adenoid region is rare and is usually due to incomplete removal of the growths, which leaves a tag on the wall of the pharynx. If so, it can be stopped by completing the operation. Otherwise it is most easily controlled by one or two sponges in the nasopharynx.

For controlling hæmorrhage Moore mentions thrombokinase or coagulen. The injection of human blood-serum or diphtheria antitoxin may be employed. In the treatment of hæmorrhage transfusion by the multiple syringe method may be used.

Dickie reports on seven thousand cases of removal of the tonsils. (Among these there were two deaths shortly after operation—one from delayed anæsthetic poisoning and another from status lymphaticus.) There were only nine cases of serious hæmorrhage, and of these four followed tonsillotomy, three followed enucleation by dissection, and only two enucleation by the guillotine. The source of the bleeding in nearly all cases was a vessel high up in the posterior pillar. Dickie states that there has been a very noticeable decrease in the amount of primary hæmorrhage since tonsillectomy has superseded tonsillotomy. Crowe, Watkins, and Rothholtz had no fatal case in one thousand operations, but hæmorrhage occurred in thirty-eight after the patient was sent to the ward. It was severe in twelve and slight in twenty-six.

Trauma.—Occasionally loose teeth may be forced out in using the mouth gag or the lower lip may be caught between the gag and the teeth. Dunbar Roy records a case of partial paralysis of the soft palate following removal of tonsils and adenoids. He thinks that it may have been due to injury to the muscles of the soft palate during the removal of adenoids, and holds that an unnecessary amount of force

and traumatism is frequently used in this operation. It is very easy to overstretch the soft palate, even by a digital examination of the nasopharynx.

Sepsis.—After enucleation of the tonsils, Marquis has noticed a good deal of reaction in the pillars and occasional œdema of the uvula; with these conditions there was associated sore throat, dysphagia, and impaired speech. Marquis believes that these troubles are of septic origin, and that they can be greatly lessened or prevented if the raw surface left by tonsillectomy is carefully painted with iodine after retracting the anterior pillar. All hæmorrhage must be controlled before the iodine is applied. Immediately after removal of the tonsil a tampon, about the size of the tonsil, is saturated with alcohol and placed in the tonsil fossa. When the hæmorrhage ceases the fossa is painted with iodine. As a rule there is almost no soreness on the day following operation. If pain be present the same solution is again applied.

Of a thousand cases in the Baltimore Report, post-operative pneumonia occurred in two instances and acute otitis media in four, suppurative cervical adenitis in two, post-operative fever in three, tetany in one, erysipelas in one, infection of the maxillary antrum in one case.

Of M'Kenzie's five thousand cases five died—one from the anæsthetic; one from post-operative pneumonia; one from meningitis following post-operative otitis media; two from general sepsis. Thus three of the five fatal cases were due to sepsis, and in all three M'Kenzie states that the mouth was the source of infection. In the seven thousand cases recorded by Dickie there were three deaths. Two have already been mentioned. The third was due to acute suppurative otitis media and meningitis. Two other cases had acute suppurative otitis media but both recovered. Dickie also mentions one case of pneumonia, one of cervical adenitis, and one of retropharyngeal abscess.

Œdema of the Larynx.—Lee Myers records a case of a patient, a powerful man of plethoric type, from whom buried and adherent tonsils were removed by dissection with the aid of local anæsthesia. No attempt was made to control the hæmorrhage as the patient, who was a medical man, wished to lose some blood. Myers was hurriedly called at midnight, as the patient was suffering from severe dyspnœa and presented a puffy and anxious appearance. Laryngoscopy showed a turban-shaped epiglottis with infiltration around. The vocal cords were not involved. The patient was given ice to suck and an ice pack was applied to the throat. Recovery took place. Myers has noted that after enucleation of buried and adherent tonsils there is often considerable œdema of the uvula and posterior pillars, especially when the patient is full-blooded.

Abscess of the Lung after Tonsillectomy.—Dr. Logan Turner has called attention to this subject in a recent abstract in this *Journal* (1917, page 360). The writings of Manges, Coakley, Richardson, and Wessler are fully dealt with. Scrutan records a case of hemiplegia after tonsillectomy in a girl of 11 years. Apparently the paralysis was present when the patient recovered from the anæsthetic. The temperature rose to 101·8° F. during the forty-eight hours following the operation, and did not return to normal for several days. Recovery from the paralysis began in the leg seventy-two hours after operation. A month later the child left hospital without assistance. Scrutan thinks that the hemiplegia was due to embolism. The operation was performed by a man seeking instruction, and lasted twenty-five minutes. There was considerable traumatism and an unusual amount of vigorous sponging, which may have caused dislodgement of a clot. Six months after operation there was athetosis in the foot and hand, while the face still showed paresis at the angle of the mouth. Gracey records a somewhat similar case in which adherent tonsils were dissected out under ether anæsthesia. There was more hæmorrhage than usual at the time of the operation. Two days later the patient complained of headache and had a rigor (temperature 105° F.). On the following day he had two rigors, and after that there was weakness of the left side, followed by complete paralysis. Convulsions set in, Cheyne-Stokes respiration developed, and death occurred ten days after operation. A post-mortem was not obtained. Gracey suggests that the hemiplegia was due to septic embolism.

Results of Tonsil Operations.

Local—I. *Faucial Pillars.*—Sheedy has examined fifty patients some months after enucleation of the tonsils and found deformed throats in forty. Five of these patients complained of difficulty in pronouncing certain words, and had a nasal intonation. The deformities were of three varieties:—(1) The pillars on both sides seemed to have disappeared, leaving a flattened surface and a narrowed opening into the nasopharynx; (2) the two pillars had joined, and the uvula was pulled to one or other side; (3) the anterior pillar had totally disappeared and the posterior pillar was cicatricial.

Dickie records the results in sixty cases of guillotine enucleation performed by himself. Of these, two had damage to one posterior pillar; five had deformity of the soft palate; twenty-nine had the pillars separated with no scarring, and the remainder had more or less fusion of the pillars. In several there was temporary nasal speech, but in none was this permanent. Complete enucleation was performed in 93 per cent. of cases.

II. *Hyperplasia of the Cervical Glands.*—This was the indication for

operation in 541 out of the 1000 cases reported by Crowe, Watkins, and Rothholtz. Of the 541 cases, 366 have been followed up. Of the latter, 122 have got no palpable glands, while in 187 others the glands are not larger than peas. In 36 the glands are still enlarged and in 21 are definitely tuberculous.

Ninety-three of the 541 patients had clinical evidence of tuberculous adenitis or a quiescent pulmonary lesion at the time of operation. Fifty-three of these have been followed up. Eight have developed pulmonary tuberculosis, 8 have tuberculous glands in the neck, 1 has died of tuberculous meningitis, and 1 has developed tuberculosis of bone.

In a large number of cases carious teeth and alveolar abscesses were treated before operation, but the writers found that the enlarged glands rarely subsided under such measures alone. They come to the conclusion that when the glands at the angle of the jaw are palpably enlarged, it is advisable to consider a removal of the patient's tonsils, regardless of their size and appearance. In the majority of cases the enlarged glands are apparently due to a chronic infection with pyogenic organisms, and subside after tonsillectomy. In the minority they are due to tuberculous infection. The writers call attention to the necessity for general hygienic treatment in addition to local treatment of the nose and throat. Tonsillectomy alone will not cure a tuberculous cervical adenitis, but it materially alters the prognosis by preventing chronic re-infection.

III. *Infective Arthritis.*—Crowe, Watkins, and Rothholz state that in these cases the peri-articular tissues are affected often with effusion into the joint. The joint trouble comes on two or three weeks after an attack of acute tonsillitis. There is little fever and no endocarditis, but the joints are swollen and very painful. Ninety-one such cases were operated upon, but only thirty-one could be followed up. In twenty-four of these the joints were normal, though in some the affected joints were much worse for a few days after the tonsillectomy. Improvement only began after two or three weeks. Four cases were improved. Two were not improved and one was worse.

IV. *Myalgia.*—These patients had pain, stiffness, and impairment of function of the muscles. Four cases were operated on, and all were entirely cured. The writers admit that these cases might have got well without operation.

V. *Rheumatoid Arthritis.*—Nine cases have been followed up, but only two are improved; two are *in statu quo* and five cases are much worse. The writers state that it is doubtful whether it is justifiable to operate in this condition. The patients are usually middle-aged, often markedly anæmic, and bear pain badly. Several of them had to stay in hospital for two or three months after operation in order to regain the physical level present before tonsillectomy.

VI. *Rheumatic Fever.*—Crowe, Watkins, and Rothholtz state that it is quite evident that the tonsils are not the only portal of entry for the organisms that cause rheumatic fever. Four of their twenty-five cases had a recurrence after leaving hospital. Twenty-one cases, however, had no recurrence.

VII. *Chorea.*—Removal of tonsils and adenoids is not a very satisfactory measure in chorea. Out of twenty-four cases, two died during the year following tonsillectomy from acute chorea. If operation is performed at all, it should only be during the quiescent stage. Thirteen of the twenty-four cases had no recurrence of chorea after tonsillectomy.

VIII. *Nephritis.*—Glomerulo-nephritis is believed to be due to a septic infection, usually streptococcal (St. viridans): hæmaturia is the most characteristic feature of the disease. Eighteen cases were operated upon. Of these, two died, four still have some nephritis, and twelve are normal.
J. S. F.

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NEW BOOK.

Lord Lister. By Rickman John Godlee, Bart. London: Macmillan & Co. Ltd. 1917. Price 18s.

It was no light task that was set Sir Rickman Godlee to write the official life of his great kinsman, Lord Lister. Let us say at once that he has proved himself equal to it, and has given us a biography worthy of his subject. We lay down his book with a feeling that we know the man of whom he writes, and not merely that we know about him —perhaps the crucial test of the art of biography.

It was Lister's hope, we are told, that the biography, which he saw to be inevitable, might be a simple record of his scientific and surgical work. This we already had in the complete edition of the *Collected Papers*, published to commemorate his eightieth birthday, and authenticated by having "received in many places the final touch of the master's hand." But that was not enough; and Sir Rickman rightly interpreted the wishes of the world that it "should know something of the inner life of one who achieved so much on its behalf."

The general reader will find in these pages the story of a singularly beautiful and beneficent life, set forth with an artless restraint in keeping with its whole tenor. Nowhere has the human interest been subordinated to the scientific, yet it is through the medium of his work that the soul of the great surgeon is revealed to us. The author has succeeded in suggesting that

> unhurrying chase,
> And unperturbéd pace,
> Deliberate speed, majestic instancy,

with which Lister pursued with singleness of purpose the one object of his life, that of "reducing in some degree the sum of human misery." Purple patches are not awanting: witness the dramatic scene at the Sorbonne in 1892, when Lister represented the Royal Societies of London and Edinburgh at the Pasteur Jubilee, and after he had given his address Pasteur rose and embraced him. "The embrace of these two men was like a living picture of the brotherly unity of Science in the relief of humanity."

To the medical reader the story makes a further appeal, as it reveals the working of a master-mind on a complex problem of great scientific and clinical importance. Step by step we follow the evolution of the antiseptic idea and the development of the system of wound treatment that revolutionised the practice of surgery. We are taken into the primitive laboratory in Lister's Rutland Street lodgings and watch into the small hours of the morning the novel experiments on the early stages of inflammation and on the coagulation of the blood, from which came the first glimmerings of his great discovery. We pass for a time to Glasgow, where we see the earliest application of carbolic acid to wounds and sores and compound fractures, and the verification at the bedside of much ingenious laboratory research; then back to Edinburgh to see that work completed and the antiseptic system firmly established—"the most brilliant and probably the happiest period of his career."

We witness that courageous decision which took Lister to London in 1877, leaving "the large infirmary, the unrivalled class of enthusiastic students, and the settled affection of his Scottish friends," in order that he might by his presence and his example convince London, which

alone had rejected the antiseptic doctrine. He did not go alone; four stalwart disciples from Edinburgh accompanied him—Watson-Cheyne, John Stewart, W. M. Dobie, and James Altham—and loyally aided him, by force when necessary, to overcome the opposition he met in his early days at King's College Hospital. Ere long he had convinced the metropolis and his battle was won.

Considerations of space forbid that we should give even a selection of the numerous passages we had marked for quotation. This is perhaps well, for few of our readers will miss the opportunity of reading the work for himself, and each may be allowed to select his own pearls.

The author has made one slip (p. 59) which, for the sake of historical accuracy, we would correct. Millbank has not disappeared; the house and gardens remain very much as Syme left them.

The publishers have given the memoir a setting worthy of the text, and have embellished it with a series of interesting portraits of members of the Lister family, beautifully reproduced.

BOOKS RECEIVED.

ABT, ISAAC A. The Baby's Food	(*W. B. Saunders Co.*)	6s.
ANDERS, JAS. M., and J. H. MUSSER. A Text-Book of the Practice of Medicine. Thirteenth Edition	(*W. B. Saunders Co.*)	25s.
BOSANQUET, W. C., and W. W. C. TOPLEZ. Green's Manual of Pathology and Morbid Anatomy. Twelfth Edition	(*Bailliere, Tindall & Cox*)	18s.
BROWN, ORVILLE H. Asthma	(*Henry Kempton*)	—
CROFTON, WM. Therapeutic Immunisation	(*J. & A. Churchill*)	7s. 6d.
DORLAND, W. A. N. The American Illustrated Medical Dictionary	(*W. B. Saunders Co.*)	21s.
GARRISON, F. H. An Introduction to the History of Medicine	(*W. B. Saunders Co.*)	28s.
GOODALL-COPESTAKE, B. M. The Theory and Practice of Massage	(*H. K. Lewis & Co., Ltd.*)	8s. 6d.
HEALTH of the Munition Worker	(*H.M. Stationery Office*)	1s. 6d.
HILDEBRAND, W. H. The Cause, Prevention, and Treatment of Cancer	(*Cole & Co.*)	—
JELLETT, HENRY. A Short Practice of Midwifery. Seventh Edition	(*J. & A. Churchill*)	12s. 6d.
KEEN, W. W. The Surgical Operations on President Cleveland in 1893	(*George W. Jacobs & Co.*)	cents. 75
KING, D. MACDOUGALL. The Battle with Tuberculosis and How to Win it	(*J. B. Lippincott Co.*)	6s.
KINGZETT, C. T. Chemistry for Beginners. Second Edition	(*Bailliere, Tindall & Cox*)	2s. 6d.
MACKENZIE, W. LESLIE. Report on the Physical Welfare of Mothers and Children	(*The Carnegie United Kingdom Trust*)	—
MONRO, THOS. K. Manual of Medicine. Fourth Edition	(*Bailliere, Tindall & Cox*)	18s.
PAGET, STEPHEN. Adolescence	(*Constable & Co.*)	7d.
PHOTOGRAPHIC Exposure Record and Diary, 1918	(*Burroughes, Wellcome & Co.*)	—
SCHUSTER, A., and A. E. SHIPLEY. Britain's Heritage of Science	(*Constable & Co.*)	8s. 6d.
STARLING, ERNEST H. The Linacre Lecture on the Law of the Heart	(*Longmans, Green & Co.*)	1s. 6d.
WILLIAMS, A. W. Venereal Diseases and their Prevention	(*H. K. Lewis & Co. Ltd.*)	6d.
WHITE, W. HALE. Materia Medica. Sixteenth Edition	(*J. & A. Churchill*)	7s. 6d.

EDINBURGH
MEDICAL JOURNAL.

EDITORIAL NOTES.

The Proposed Ministry of Health.

THE two Royal Colleges of Edinburgh have recently had under consideration the proposal to establish a Ministry of Health, and have issued pronouncements on the subject, of which the following are the general conclusions:—

The Royal College of Physicians of Edinburgh is of opinion that it is essential, in the public interest, that a Government Department should be erected to deal exclusively with health.

The Royal College suggests:—I. That the Department should consist of the Minister and a Board of Health, of which the Minister should be chairman and whose members should be elected on the ground of experience and interest in matters pertaining to health.

II. That the purposes of the Department should be—(1) To administer the Health Acts. (2) To devise executive measures for dealing with health problems not hitherto defined by legislative measures. (3) To institute inquiries with a view to introduce measures for improving conditions affecting health. (4) To develop facilities for investigation of problems in health and disease as they may arise.

III. That the Board should include three groups of members—(1) Administrative officials. (2) Laymen with wide experience of health problems, or in the administration of hospitals and other health agencies, official or voluntary. (3) Medical members who have had experience in—(*a*) Public health service; (*b*) general practice; (*c*) special clinical departments, including industrial medicine; (*d*) medical research; (*e*) medical statistics.

WILLIAM RUSSELL, M.D., *President*.
A. DINGWALL FORDYCE, M.D., *Secretary*.

The Royal College of Surgeons of Edinburgh unanimously adopted the following recommendations:—

"1. That whereas under the present system there is divided authority and responsibility among various Government departments and local health authorities, with consequent overlapping and loss of efficiency in administration, the Royal College of Surgeons cordially supports the proposal for the formation of a Ministry of Health which shall have full powers (under Parliamentary control) to deal with all matters bearing upon National Health.

"2. That owing to differences in local circumstances and legal procedure, there should be a Ministry of Health for Scotland, with direct Parliamentary representation, apart from that for England and Wales.

"3. That in view of the economic and other reasons which may make it difficult to obtain a separate Minister of Health for Scotland, the desired purpose might be secured by an extension of the duties and powers already entrusted to the Local Government Board for Scotland with the Secretary for Scotland as Minister of Health.

"4. That as the whole subject, in which this College and the medical profession generally are deeply interested, is of national importance and great magnitude, this College respectfully submits that before any Bill is introduced to Parliament the Royal College of Surgeons and other bodies representative of the medical profession should be consulted as to its terms.

"5. That while the time is ripe for consideration of the many complex problems involved in a Ministry of Health, it is not expedient to complete the necessary enactments before the conclusion of the war."

R. M'Kenzie Johnston, M.D., *President.*
George Mackay, M.D., *Secretary.*

We have been requested to call attention to a handbook on the *Health of the Munition Worker* * published by the Ministry of Munitions. The book has been issued by the same committee that has already prepared a number of important memoranda on industrial subjects, some of which, notably that on industrial fatigue, have attracted widespread interest. The handbook, in a sense, is the epitome of their labours, and we would urge that it be widely read, not only in view of the existing state of industry, but as a corrective to many false notions which are widely current as to output and other subjects, and as a means to the wider diffusion of knowledge bearing on the social problems which will arise after the war.

In spite of all the troubles of Belgium, one Belgian medical journal continues to appear regularly—the *Archives médicales Belges*—which is now published in Paris, and is the official organ of the Belgian medical service. Our courageous contemporary deserves every acknowledgment; it is to be hoped that in the not too-distant future it may again spring up from its native soil.

CASUALTIES.

Died on service, Lieutenant Percy Ashworth Wedgwood, R.A.M.C.

Lieutenant Wedgwood obtained the Qualification of the Scottish Triple Board in 1898.

Died of wounds received in action, Captain Thomas Forrest Craig, R.A.M.C.

Captain Craig graduated M.B., Ch.B. at Edinburgh University in 1910.

Dr. Francis D. Boyd, C.M.G., has left Edinburgh for Egypt, on his appointment as Consulting Physician to the British Army there.

* London: H.M. Stationery Office, 1917. Price 1s. 6d. net.

GUNSHOT WOUNDS OF THE PERIPHERAL NERVES, WITH REFERENCE TO THE INDICATIONS FOR RESECTION AND SUTURE.*

By EDWIN BRAMWELL, M.B., F.R.CC.P.Ed. and Lond., Capt., R.A.M.C. (T.).

THOSE of you who attended last year's Morison Lectures will recollect that I chose as the title "Paralysis Occurring as a Sequel to Gunshot Wounds of the Limbs." My purpose in so doing was a threefold one: Firstly, because these cases, which are so common, constituted the largest group in my experience of war neurology up to that time; secondly, because they are often incorrectly diagnosed and mismanaged; and, thirdly, because this title permitted the inclusion of the functional palsies, afforded opportunity of discussing their etiology and symptomatology, enabled one to emphasise that these functional palsies are to be clearly distinguished from wilful simulation, and at the same time allowed one to indicate the manner in which they are to be approached and dealt with.

Last year I referred to the etiology and pathology of gunshot wounds of the nerves, and I cited cases illustrating the features of individual nerve root, plexus, and peripheral nerve palsies. In introducing the subject I reminded you of certain elementary considerations, viz. that the nervous system is composed of an infinite number of neurones or nerve units, each neurone comprising a cell body, its branches, and the axis cylinder or nerve fibre which arises from it; that three kinds of neurone enter into the composition of a mixed nerve—the motor neurone, the sensory neurone, and the sympathetic neurone; that when a nerve fibre is divided or destroyed at any point in its course that portion of the fibre which is separated from its corresponding cell body degenerates, hence when a peripheral nerve is severed degeneration occurs in all its component parts on the distal side of the lesion; and that when the ends of a divided nerve are brought together and maintained in contact, the axis cylinders of the proximal segment grow downwards into the distal segment of the nerve, with the result that more or less complete regeneration may occur in the peripheral portion of the nerve with more or less complete restitution of function.

I propose to devote my present remarks, in the first instance,

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to a further consideration of gunshot wounds of the peripheral nerves, and I shall commence by referring to the symptomatology in so far as it has a bearing upon the diagnosis of nerve interruption and the indications for resection and secondary suture. If I do not bring forward detailed records of individual cases in support of my contentions, I would have you understand that the conclusions advanced, except where specifically stated to the contrary, are based upon or corroborated by personal experience.

A distinguished French neurologist has affirmed that the question of diagnosis in gunshot wounds of the peripheral nerves constitutes the most delicate problem in war neurology. Although this expression of opinion may not meet with universal acceptance, there can be no doubt that the subject is infinitely more complicated than would at first sight appear to be the case. Further, refinement in diagnosis is here no mere matter of academic or scientific interest, but is essential if the best results are to be obtained.

Let us pause, then, for a moment and glance in passing at some of the requisites for such a diagnosis and at some of the difficulties which these cases present. Although anatomical knowledge is essential, it is altogether a mistake to suppose that this is all that is required. It is necessary in addition that the clinician should be familiar with the examination of the function of the individual muscles, that he should know how to elicit abnormalities of sensation, and that he should be acquainted with the sensory defects produced by lesions of the individual nerves. Again, he must also be able to recognise and differentiate the superadded functional symptoms which, as I have pointed out, so frequently occur in association with these peripheral nerve palsies due to the wounds of war; while in deciding for or against operation, the diagnostician should be cognisant of the effects produced by interference with the vascular supply of the limb—an aspect of the subject which does not perhaps receive the attention it deserves.

Assuming an appreciation of these matters, we are now in a position to approach the symptomatology of gunshot wounds of the peripheral nerves, with special reference to the diagnosis of nerve interruptions and the indications for resection and secondary suture.

A variety of different lesions are met with in peripheral nerves as a direct or indirect consequence of gunshot wounds. Thus a nerve may be completely or in part divided; it may be concussed

or contused; it may be compressed by surrounding structures; or it may be the seat of a scar which offers a more or less impermeable barrier to the downgrowth of the young nerve fibrils. The relative frequency of these different lesions is difficult to estimate. Complete division is comparatively uncommon in relation to the total number of cases. On the other hand, cases in which a nerve has been completely divided are without doubt relatively more frequent in the material met with in a general hospital in this country than in a hospital in which all the cases are directly admitted from the firing line.

The class of case with which we are more especially here concerned is that in which there are indications of complete loss of function in a nerve or in a portion of a nerve. Under such circumstances the problem arises, Will the nerve recover without operation or will it not? The sooner this question can be answered positively one way or the other the better, for to delay operation, when recovery is otherwise out of the question, is not only to waste time, but also, it would seem, to render improvement slower and to impair the chances of its being complete. But you will say, if this is so, why not operate at once on every case and be guided by the appearances met with when the nerve is exposed? My reply is, "Firstly, that even under the most favourable circumstances—accurate adaptation of the extremities of the divided nerve, complete asepsis, and patient and prolonged after-treatment — recovery after secondary suture is always a tedious process, and is seldom, if ever, complete; secondly, that complete recovery may occur spontaneously in cases in which the facts point in the first instance to complete abolition of conduction; and, thirdly, that in a certain proportion of cases—and this remark is particularly applicable to cases in which operation is carried out at an early date—it is difficult or impossible from inspection and palpation of the exposed nerve to decide whether, or to what extent, resection and secondary suture are called for, or whether a more satisfactory result will not be attained if no attempt is made to interfere with the structure of the nerve."

What, then, are the sources from which data may be derived bearing upon the chances of spontaneous recovery?

The history, needless to say, may afford some information as to the nature of the lesion. Thus if the onset of the paralysis was not simultaneous with the wound, division of the nerve may be excluded. Further, if a pronounced paralysis develops some

time after the wound, the palsy is almost certainly functional. Again, if the paralysis increases slowly, it may be due to pressure produced by scar tissue or callus; this, however, is a sequence of events which, although it might be expected from theoretical considerations to occur, is in my experience but seldom met with in actual practice, the explanation probably being that the nerve, which at a later date is compressed, is put out of action at the time of the wound and the effects of the concussion so produced have not passed off at the time pressure begins to play its part.

The extent and situation of the wound are occasionally helpful in determining the nature of the lesion, for, when a large scar exists indicating considerable loss of tissue, the inference may be justifiable that a portion of the nerve has been carried away or destroyed by the missile. Where this is so, the breach in the nerve and in the tissues is generally so pronounced and the scar so extensive that nerve suture is out of the question. Transplantation and nerve grafting are justifiable procedures under these circumstances. The exact sites of the wounds of entrance and exit, needless to say, commonly afford direct evidence as to the point at which the nerve has been injured. One meets with cases, however, and several instances have come under my observation, in which two direct wounds existed, either of which from its position might have been responsible for the symptoms and in which only the most careful examination permits of a definite conclusion as to which has been their cause.

Important information may sometimes be derived from the examination of the nerve at the site of injury. Most of the peripheral nerves of the body lie comparatively superficial in some part of their course. When a nerve is wounded in such a situation, valuable indications may be obtained by palpation in the region of the wound—a method of examination which should never be omitted. Thus on palpation an apparent breach of continuity in the course of the nerve, a localised neuroma, a fusiform thickening which suggests that the nerve trunk is surrounded by fibrous tissue, or it may be two neuromata with an intervening gap, may be detected. The existence of a neuroma is significant, for, since it is formed by the windings of the young nerve fibrils which are unable to find or penetrate into the distal portion of the nerve, its presence indicates that there is either a severance of the nerve with separation of its extremities or a more or less impermeable barrier in the substance of the nerve through which the nerve fibrils are unable to pass.

Among the various conditions encountered when the nerve is exposed at operation are the following:—The nerve may be completely severed, the bulbous extremities being separated perhaps from one another by a considerable distance; it may be partially divided or merely nicked; it may be firmly embedded in dense, fibrous tissue which is obviously strangling it; it may be the seat of a fusiform swelling; it may be very much attenuated at the point of injury, with neuromata situated at either extremity of the attenuated portion; again, it may appear slightly congested; it may present a healthy appearance, or it may seem normal to the eye, although on palpation a local induration is detected in its substance.

What procedure is the surgeon to adopt in dealing with these various lesions with a view to the re-establishment of conduction? Obviously when the nerve is actually divided his aim must be to bring together the proximal and distal extremities and fix them in accurate apposition after he has removed the neuromata and thus abolished all obstruction to the downward growth of the new axis cylinders. The same procedure in a modified form is indicated in cases in which there is a partial division of or a nick in the nerve. Under these circumstances, the divided surfaces are to be freshened and maintained in accurate contact. Similarly when, although there is no breach of continuity, the nerve is reduced to a strand which, even granting that it is composed of nerve tissue, is so attenuated that it cannot possibly be of much service as a conductor, both the neuromata and the intervening portion should be excised and secondary suture carried out. If the nerve is surrounded and compressed by fibrous tissue, this must be removed.

The problem of intervention is much more difficult when the surgeon finds only some slight thickening of the nerve, when a neuroma occupies a portion of the transverse section, or when, although the nerve appears practically normal to the eye, it feels somewhat hard and indurated on palpation. Now, cases of the type just mentioned, in which, from the appearance of the nerve as seen at operation, it is impossible to say whether a resection should or should not be carried out, form, as I have said, a certain proportion of those operated upon.

Consequently the question arises, Do clinical signs exist which are so definite that they will enable the neurologist, when he examines a case soon after the original injury, to conclude that the nerve is actually divided or that there is at the level of the

wound an insuperable impediment to the downgrowth of the young nerve fibrils? In other words, are the symptoms sufficient to justify the clinician in advising resection and suture when the nerve is exposed by the surgeon soon after the original wound and found to present a comparatively healthy appearance? The answer to this question is in the negative, for although it is possible to diagnose what may be termed the physiological section of a nerve—in other words, to recognise that there is complete interruption in conduction in the course of the nerve at the level of the injury—the symptoms of disturbance of function do not permit of a distinction between actual division of the nerve with separation of its extremities or abolition of conduction due to the presence of impervious tissue in the substance of the nerve on the one hand, and, on the other, complete interruption, which is unaccompanied by structural changes interfering with the regeneration of the nerve. This being so, since it is obviously unwise to resect and suture a nerve in which more or less complete regeneration may ultimately take place, and since it is generally acknowledged that a short delay can probably do little harm, neurologists are agreed that, in cases in which the symptoms point to complete interruption in the whole or in a part of the nerve trunk, it is advisable, in the absence of an obvious breach in the continuity of the nerve, to delay operation until such time as the clinical phenomena indicative of regeneration have had ample time to make themselves manifest rather than to operate and chance meeting with a nerve from the appearance of which it is impossible to conclude whether resection and secondary suture are advisable or whether regeneration will take place if this procedure is not carried out.

For what period, then, is it advisable to delay operation in the case of a nerve which is in whole or in part the seat of a complete interruption? In other words, when will clinical evidence of regeneration begin to assert itself? Deferring for the moment the consideration of the signs of regeneration, I may say that there is considerable difference of opinion regarding the desirable duration of what might well be termed the period of expectation. Déjerine, for instance, says: "We believe that the persistence of complete physiological interruption three months after the wound enables one to conclude the existence of a histological interruption. In other words, the existence of a complete physiological interruption of a nerve in the third month fter the wound proves two things—firstly, a histological inter-

ruption, and, secondly, the presence of an obstacle which prevents its restoration." This author would consequently advise that operation should be undertaken if after three months there is no sign of regeneration. The majority of authorities act on this view. Some, however, prefer to wait considerably longer, since they hold that if a longer period is allowed to elapse there is little, if anything, lost, either as regards the subsequent rate of recovery or its ultimate degree.

Let me in this connection once more emphasise the fact that each nerve consists of numerous bundles of fibres, that the nerve may be partially divided or the seat of an impermeable scar which involves only a portion of its transverse section, and that, consequently, regeneration may be perfect in a certain number of its component fibres, while in others regeneration may be impossible. Hence it is not justifiable to assume—a fact which is apt to be lost sight of—that recovery is necessarily to be expected in all the fibres of the nerve below the level of the injury because improvement is observed to be taking place in the power of certain muscles or in the sensibility of certain areas of skin to which the nerve in question is distributed.

I wish to draw your attention to the signs justifying a diagnosis of complete interruption which, as I have mentioned, are identical whether the interruption be anatomical, histological, or physiological, before proceeding to consider the clinical evidence indicative of regeneration and certain fallacies which arise in this connection.

Firstly, those muscles which are supplied by the injured nerve below the seat of injury are completely paralysed, hence it is necessary to examine the individual muscles innervated by the nerve in question.

Secondly, the paralysed muscles lose their tone. Loss of tone, or atonia, a sign which may be judged of or estimated by the abnormal positions of a limb or of a segment of a limb, or by the abnormal degree of passive movement which is permitted at any given joint in consequence of an involuntary diminution of resistance in paralysed muscles, is often difficult to detect. Atonia may be easily demonstrated in such muscles as the dorsiflexors of the foot or hand, while in the case of others it is impossible to prove its presence. When eliciting this sign the muscles of the corresponding healthy limb are to be taken as a standard. Great variations in the degree of passive movement possible at any given joint are met with in different individuals, while in these cases of peripheral

nerve injury, limitation of movement—a consequence of scar formation or of structural changes in the joints or muscles directly caused by the wound—is a source of fallacy which must be borne in mind.

Thirdly, the affected muscles waste. Even in cases of interruption, in which there is eventually complete spontaneous recovery, I would have you note that extreme wasting occasionally takes place. The case of an officer with a musculo-spiral paralysis due to a gunshot wound, in whom, although there was very great wasting of the triceps and extensors of the wrist and fingers, spontaneous recovery occurred, was a striking instance in point. It is possible in this case that the atrophy might have gone on to complete degeneration of the muscles had not regular massage and electrical treatment been carried out.

Fourthly, certain electrical changes take place in the muscles. Thus, if a case of complete interruption is examined ten days or more after the wound, the phenomena known as the reaction of degeneration are observed. Ultimately, if conduction is not re-established, the galvanic response gradually diminishes and eventually disappears, the muscle tissue having largely degenerated. It is interesting to note that in some cases in which the muscle has not been treated, and no longer reacts to galvanism, a return of the galvanic excitability may be observed within a few days if the muscle is maintained in a position of relaxation by means of splints. Now, there are three points in relation to the electrical examination which I wish specially to emphasise. In the first place, one may meet with the reaction of degeneration in cases in which there is ultimately spontaneous recovery. Again, if the paralysed muscle has been regularly treated by massage and electricity, the response to galvanism may be a fairly brisk one, very similar to that met with in a healthy muscle, while there may be no polar inversion. Whether it is the massage or the electricity which is responsible for this I cannot say, although one is naturally inclined to credit the latter. Further, I have repeatedly found, although I am not prepared to say that this is a rule without exception, some return of voluntary movement in paralysed muscles which at the time did not respond to faradism. These observations demonstrate that the electrical examination as carried out by the faradic and galvanic currents does not enable us to decide that in any given case the lesion is of such a nature that spontaneous recovery will not take place. I wish to emphasise this matter, since cases have been repeatedly referred

to me with the request that I should test the electrical reactions under the erroneous impression that by so doing it would be possible to determine the advisability or not of operation. Although the electrical examination does not necessarily permit of a differentiation between physiological and anatomical interruption, it is undoubtedly of diagnostic value in certain cases of gunshot wounds of the nerves, and notably so in peripheral paralyses in which there is a superadded functional palsy, since it enables one to arrive at a conclusion as to the extent and degree of the organic paralysis. Again, the faradic current may be employed during the course of an operation to test the excitability of an exposed nerve, and this method of examination may prove helpful in the case of partial lesions in enabling the surgeon to locate in the nerve trunk those fibres the continuity of which has not been interrupted. While speaking of electrical diagnosis I should like to take the opportunity of correcting a very prevalent impression, namely, that the clinician, in order to be an expert in electrical diagnosis, must be an expert electrician. This is a misconception which is quite erroneous. A comparatively simple electrical apparatus is all that is required to obtain practically all the available known facts bearing upon diagnosis. It is essential that the physician should be an expert as regards his practical ability to elicit these facts and as to their interpretation so far as this is known, but the most elementary knowledge of electricity and of electrical apparatus is all that is required for this purpose.

When considering the scope of electricity in diagnosis it is convenient to refer to another method of examination which has in the past received but scant consideration at the hands of the clinician, but which, as recent experience has shown, affords data in cases of peripheral nerve palsy similar to those obtained by electrical methods. I refer to the direct mechanical excitability of muscle. As is well known to you, when one strikes a relaxed muscle with a suitable percussion hammer, the muscle responds by contracting briskly. It is not my intention to discuss the nature of this contraction and allied manifestations; at the same time I would, in passing, remind you that the direct mechanical excitability of muscle is something quite distinct from a tendon jerk. This is a matter of no little importance. I have, for instance, seen a physician, when examining the triceps jerk, strike the triceps muscle some two inches above its insertion into the olecranon process, and, obtaining a contraction in the muscle and a consequent movement of extension at the elbow, demonstrate to the

onlookers the presence of a triceps jerk—a conclusion altogether unwarranted. In order to prove that the mechanical excitability of a muscle and of its corresponding tendon jerk are quite independent phenomena, let me draw your attention to one or two clinical observations. If in a case of tabes, in which the knee jerk is absent, the vastus internus muscle is struck with a percussion hammer, the muscle not only contracts, but the contraction is more pronounced than is the case in a normal muscle. Again, if the same procedure is carried out in a case of spastic paralysis in which the knee jerk is increased, it will be found that there is no increase in the contraction of the muscle when the latter is directly struck. In other words, the mechanical excitability of the muscle may be increased when the corresponding tendon jerk is absent, and *vice versâ*. Let us look at the changes which occur in the direct mechanical excitability of a muscle, the nerve to which has been divided. In the first place, you will find that, if a muscle responds to faradism, it contracts sharply on percussion. Again, you will find that, when a muscle no longer contracts to faradism, but responds in a sluggish manner to the galvanic current, the contraction which occurs on direct percussion is a slow one, reminding one of the response obtained in the classical reaction of degeneration. Further, when the muscle no longer reacts to galvanism, the response to mechanical stimulation also disappears. It is said to persist—a point which I have not myself demonstrated—for some little time after the galvanic excitability is lost. I have drawn your attention to these points since you will find them, as I have done, of value and convenience in diagnosis, for the mechanical excitability of muscle affords, as I have indicated, analogous data, and consequently permits of similar inferences to those obtained from the electrical examination.

Fifthly, as regards the disturbances of sensation which accompany lesions of the peripheral nerves, the work of British neurologists stands pre-eminent, for the experimental researches of Head and Rivers and the rich clinical observations of the former in junction with Sherren and Thompson and those of Trotter are everywhere acknowledged as classical contributions. In relation to the problem more particularly under discussion, we are especially concerned with the sensory manifestations met with in so far as they enable us to arrive at a conclusion which will directly aid us in the diagnosis of complete interruption and its cause. When a sensory or mixed nerve is divided, and this statement applies alike to physiological and anatomical interruption, sensibility is

completely abolished in the area supplied by the nerve. Hence complete abolition of sensation in the region innervated by any given nerve indicates complete interruption in the conduction of sensory impressions. Now, there are several facts to which I wish to allude in this connection. In the first place, you will remember that the extent of the sensory loss produced by section of a nerve is not necessarily co-extensive with what one might term the gross anatomical distribution of the branches of the nerve as demonstrated on the dissecting table. Again, it is almost unnecessary to remind you that the field of sensory loss is not equally co-extensive for all forms of sensation. Further, the extent of the sensory loss varies with the level of the lesion, while the relative area of the different forms of anæsthesia also varies with the height at which the nerve is injured; and, lastly, variations in the sensory distribution are met with in individual cases. Hence, when it is desired to determine whether there is or is not complete interruption in the conduction of sensory impressions, it follows that it is essential to know the effects produced by section of the nerve in question and their variations in order that these may be compared with the anæsthesia present in the case under examination. For all practical purposes it is sufficient in cases of peripheral nerve injury to map out the area of sensory disturbance for tactile and painful impressions.

There are two defects of sensibility which call for special mention, since, according to Déjerine and Mouzon, they are constantly observed in cases in which interruption is complete. One is absence of pain when pressure is applied to the nerve trunk below the level of the lesion; the other, complete absence of pain when the paralysed muscles are subjected to pressure.

Summarising the diagnostic evidence bearing on the question of complete interruption and its cause in relation to operation one may say:

Firstly, that the history of the case, the situation and extent of the wound, the local examination of the nerve at the level of the injury, and the clinical facts indicative of disturbance of function are all to be taken into account in arriving at a conclusion.

Secondly, that in the great majority of cases the only data bearing on the point are to be derived from the accompanying disturbance of function in the distribution of the nerve.

Thirdly, that although there is no single phenomenon which is pathognomonic of complete interruption, it is possible, from

the clinical signs, to express a positive opinion as to whether or not there is complete abolition of conduction—in other words, whether there is or is not complete interruption of function in the nerve trunk at the level of the wound—the most important indications of complete interruption of conduction being complete and persistent paralysis of, and absence of tone in, the muscles supplied by the injured nerve below the point of injury, absence of all pain on pressure over the paralysed muscles, persistent sensory loss which corresponds in quality and extent to the cutaneous, osseous, and articular distribution of the nerve, and absence of tenderness on pressure over the nerve trunk below the lesion.

Fourthly, since the clinical signs indicative of complete interruption neither throw light upon the nature of the lesion nor upon the probabilities of ultimate spontaneous recovery; since in a certain proportion of cases—this applies especially to the first few weeks after the wound and before a neuroma has had time to develop—the appearance of the nerve when exposed by the surgeon may not permit of a definite conclusion as to the advisability of resection and secondary suture; since recovery after this operation is a slow process which is rarely complete; since pronounced spontaneous improvement is often observed; and since a delay of two or three months probably affects but little the rapidity and degree of ultimate recovery after operation, it is generally regarded as advisable to delay the decision as to resection for a period of three months, by which time clinical evidence of regeneration will have had time to manifest itself.

(*To be continued.*)

REMARKS ON ACQUIRED ACHOLURIC JAUNDICE (HÆMOLYTIC ICTERUS).

By J. EASON, M.D.

It would appear that no very important additions have been made to what was known regarding acholuric jaundice since the critical summary by Macintosh, Falconer, and Anderson appeared in this *Journal* in March 1911 as a valuable appendage to the record of a case illustrating the congenital type of this malady. I believe, however, it may truly be stated that the material accumulated since then has revealed more fully and clearly the features of the acquired type. The following record of a case of the acquired type prefaces some remarks on this subject as well

as on the differential diagnosis from other splenomegalics. An important aspect of the therapeutic problem in the case is briefly discussed:—

D. C., aged 17 years, a visitor to this country, was born in Buenos Ayres, where his present home is. He was seen at the Royal Infirmary, Edinburgh, on 3rd June 1915, complaining of weakness and want of vitality.

Family History.—The father, a teacher of languages, is healthy, and the paternal antecedents regarding whom definite information could be obtained had lived to old age. One ancestor died at the age of 99 and others were over 90 years of age at death. The mother states she is healthy but nervous. At a glance one can say she suffers from exophthalmic goitre. The maternal grandmother of the patient also suffers from goitre which, from the description given, appears to be of the simple type. Both father and mother of the patient were born in this country. Two brothers and two sisters are healthy. The mother had no miscarriages or still-births, and all the children have survived. No member of the family or antecedents has been known to suffer from jaundice or enlargement of the spleen.

Previous Illnesses.—In the early years of his life the mother observed nothing unusual regarding the boy's health and appearance. After infancy he became liable to colds and apparently suffered from adenoids. Ultimately these were removed by operation. When he was 7 or 8 years old he had a serious illness, the nature of which was never clearly explained to the parents. During this illness he suffered from pains in the joints, and was given aspirin, from which benefit was derived. The mother was led to understand that the condition was not true rheumatism but something of an allied nature. There was no eruption or any discoloration of the skin at this time. At Monte Video, during the convalescence from this illness, he became suddenly ill when walking on the beach. His legs and feet became very painful, but there was no skin eruption. The nature of the condition was again rather unusual. Three doctors were consulted, and finally he was placed in charge of a specialist in children's diseases. He was so unwell that his return to Buenos Ayres was delayed. After two months' treatment he recovered sufficiently to return home, but was unable to attend school for a period of two years. During the greater part of these two years he was kept very quiet, not being allowed to read or even to look at pictures. Regarding the nature of the illness at this time I could not obtain definite information from the mother. After she had had some time to think the matter over she asserted confidently that the trouble was on both sides of the chest, but she did not know whether the lungs or pleuræ were affected.

After two years of ill health he recovered sufficiently at the age of

10 to attend school for two years. He had to give up again when he was 12, because of a purpuric eruption on the thighs, legs, and feet. From this time he has never been in a good state of health—a period of five years. In October 1913 he began to have trouble with pain across the abdomen, and one night it became particularly severe. Hot cloths were applied. On the next day his skin was yellow. His own doctor was absent in Europe, and the medical attendant believed the boy had disease of the kidney, but this was never confirmed. From time to time the paroxysms of pain returned, but he was always able to be up out of bed the next day. There is no definite information on the point, but in the light of subsequent events it may be regarded as more than probable that the pains were due to the condition of the spleen. In addition to the paroxysms of pain which supervened without any apparent exciting cause, he also suffered pain in the left side if he ran about. Sometimes the pain occurred if he walked a short distance. In summer, especially, walking exercise was usually impossible.

In addition to the foregoing symptoms there is also a history of febrile attacks, sometimes associated with mild delirium. There is no history of malaria.

Since coming to this country he has felt much stronger, and he can walk and climb with considerable freedom and without any pain.

Examination.—The general appearance is that of a fairly well-grown boy. The state of nutrition is good. The muscles and bones show average development. The skin and mucous membranes are definitely jaundiced—a pale crocus-yellow colour. There is no other abnormal pigmentation. The temperature is normal.

Alimentary System.—The condition of the teeth is good. The hard palate is somewhat highly arched. The left tonsil is slightly enlarged. The tongue is moist and clean. The abdomen in the erect attitude shows a slight general fulness in form, not due to obesity. The veins on the abdominal wall are not prominent. The liver is neither enlarged nor small. There is no ascites nor hæmorrhoids. The state of the digestion is entirely satisfactory. The history is that the bowels have always acted regularly and the stools have been normally formed and coloured.

Hæmopoietic System.—The thymus and lymphatic glands do not appear to be enlarged. The spleen is very large, being palpable at the umbilicus; it is hard and without tenderness. The splenic dulness extends upwards to the eighth intercostal space in the mid-axillary line to the seventh in the anterior axillary line, and downwards to the costal margin. The characteristic splenic outline is retained. The whole upper left quadrant of the abdomen is decidedly dull on percussion. The thyroid is not enlarged. The mucous membranes are pale and jaundiced. The *bruit de diable* is marked. Hæmic murmurs

are also very well heard over the eyeballs. Epistaxis occurs occasionally, not frequently. There is no history of hæmorrhages either from the bowel or per urethram. The bones are not tender on palpation.

On 6th June 1915 the condition of the blood was as follows:—Red blood corpuscles 3,060,000; Hb 50 per cent. (Haldane); colour index, ·83; white blood corpuscles, 4300; polymorphonuclears, 68 per cent.; small leucocytes, 21·5 per cent.; large leucocytes, 8 per cent.; eosinophiles, 2·5 per cent.; no myelocytes.

There was marked anisocytosis. Megaloblasts and mast cells were seen. There was very marked punctate basophilia of reds and polychromasia. There was no opportunity for examining the cells after vital staining. The resistance of the reds to hypotonic saline solutions was decidedly diminished, hæmolysis occurring quickly and completely with 0·45, and even 0·6, while resistance was first shown to 0·75.

In this case there was thus a considerable degree of anæmia, the red cells and leucocytes participating equally in the cellular poverty. The differential count showed no departure from the normal, the most extreme change shown being merely the approach of the large lymphocytes to the upper physiological percentage limit. The most important change observed undoubtedly was the diminished resistance of the red cells to the hypotonic saline solutions. The polychromasia, and especially the presence of megaloblasts, were significant of such bone-marrow reaction as occurs only in major anæmias. The lungs were normal. The heart outline was slightly increased without other abnormalities in the circulatory system. There was no clubbing of fingers. The urine was dark and clear with a reddish tinge. There was no hæmoglobin present. No bile-pigment was demonstrable with fuming nitric acid or by the iodine test. Ehrlich's aldehyde reaction (paradimethylaminobenzaldehyde) gave a decided positive reaction for urobilinogen and urobilin without heating. It was very marked after heating. The von Pirquet reaction was slightly positive.

Unfortunately the boy's mother did not allow him to come into hospital. She was anxious to fulfil a programme of visits to friends, which at the same time would give her son the opportunity for benefiting from the hill air of Scotland. He left Edinburgh shortly thereafter. Sufficient information had, however, been obtained for the diagnosis to be made, although a number of interesting points remained undetermined. It was unfortunate that the blood could not be examined bacteriologically or for hæmolytic properties, the blood-serum for hypertonicity, and the stools for parasites.

From the record of this case it will be at once apparent that

	1900. Congenital Acholuric Icterus (Chauffard-Minkowski).	1898. Acquired (Hayem-Widal).	1913. Hæmolytic splenomegaly (Banti).	Paroxysmal Hæmoglobinuria.
Etiology.	*Hereditary—Familial.*	*No family history of Jaundice.* Various infections and toxæmias. Sometimes follows syphilis, malaria, etc.		*Syphilis*, congenital or acquired. Sometimes several members of family affected.
Course.	On the average, mild: chronic, with exacerbations.	Acute or chronic, with exacerbations, mild or malignant. Ushered in by a definite illness.	Chronic.	Chronic.
R. B. C. and Serum.	*Microcytes a special feature.* Anisocytosis, polychromasia, reticulated cells increased. Normoblasts, may be megaloblasts. Auto-agglutination of reds, but not constant. Diminished resistance of reds, but not essential. Isolytic property of serum occasionally found, but usually absent. Cells usually 3,000,000.	Greater degree of anæmia than in former is the rule, with significant signs such as dyspnœa, etc. The cellular changes do not distinguish it from the family form. Auto-agglutination is usual. Auto- and iso-hæmolytic serum has sometimes been obtained. Diminished resistance of reds sometimes more difficult to demonstrate. A few cases have shown no resistance abnormality. Cells may be 1,000,000.	Slow onset of anæmia, with remissions. May become intense. Poikilocytosis. Normoblasts; increase of reticulated cells. * *No crises of deglobulisation* (Banti), which, it is alleged, distinguishes it from the Hayem-Widal form. Diminished resistance.	Anæmia may be moderately severe after a series of crises *Auto- and iso-hæmolytic serum.* Diminished resistance in some cases.
C. I.	Low or high.		Low.	
W. B. C.	Leucocytosis or leucopenia, may be relative lymphocytosis or lymphopenia. Myelocytes, and may be myeloblasts.		Absolute leucopenia (neutrophil); mild mononucleosis of large cells, with pale nucleus. *Compensating lymphocytosis* (also regarded by Banti as distinguishing this from the Hayem-Widal form). No myelocytes.	
Icterus.	Very rarely none. Intensity varies, increasing after pain in splenic region. *Bilirubinæmia.*	Present, may be intense. Bilirubinæmia.	Moderate.	Usually mild and intermittent.
Abdominal pain.	Intermittent.		Present.	Discomfort; sometimes pain.
Urine.	Urobilinuria; *no bilirubinuria.* May be hæmoglobinuria.	Urobilinuria; *no bilirubinuria.* May be hæmoglobinuria.	Urobilinuria. Bilirubinuria.	Urobilinuria. *Hæmoglobinuria.*
Fæces.	Normal colour.	Normal colour.	Normal colour.	Normal colour.
Tendency to Hæmorrhages.	May be epistaxis, purpura. No special tendency to portal hæmorrhages.			
Spleen.	Enlarged; intermittently more pronounced.	Enlarged.	Enlarged.	Much enlargement; usually temporary. Slight enlargement between crises.
Liver.	May or may not be slightly enlarged from hyperæmia.	May be slightly enlarged.	Enlarged.	
Prognosis.	Good as to life. More serious during gravidity.	Various. Some cases remain benign, and some of the severer improve when the underlying cause is successfully treated.		Good as to life.

* If confirmed, the phenomenon is unique in the group of hæmolytic diseases.

Etiology.	1894. Banti's Disease. *Occurs in young adults.* Cause unknown; probably infection.	1882. Gaucher's Disease. *Family predisposition.* Ascribed to various causes. Endogenous toxins, protozoa. Tuberculosis, probably not malignant. Several members of a family may be affected.	..	..
Course.	Chronic in three periods.	Chronic. An acute form described in 1914. *Onset before age of* 13; insidious. General condition remains good till late.	..	..
R. B. C. and Serum.	No normoblasts. Resistance of cells not diminished.	Chlorotic anaemia sets in late. No normoblasts or megaloblasts. No haemolytic phenomena.	..	..
C. I.	Low.	Normal; later becomes low.	..	..
W. B. C.	Leucopenia usual; mononucleosis; absolute lymphocyte leucopenia; no myelocytes.	Leucopenia. Differential count normal. Lymphatic glands not enlarged.	..	..
Icterus.	Mild and late. No conjunctival thickening, as in Gaucher's disease.	None. Pigmentation of neck, face, and hands, and *conjunctiva* on which there is a *wedge-shaped thickening.*	..	..
Abdominal pain.	*Absent.*	Absence of any great pain.	..	..
Urine.	No urobilinuria (Banti), but this probably incorrect. Increased nitrogen excretion (Umber).		..	..
Fæces.			..	..
Tendency to Hæmorrhages.	Submucous and subcutaneous; may be fatal. Portal hæmorrhages.	May be epistaxis or other hæmorrhages. Not severe.	..	..
Spleen.	Primary enlargement.	*Progressive* enlargement, retaining normal form. Larger than in Banti's disease. Primary.	..	..
Liver.	*Cirrhotic;* at first large, later contracted. *Ascites;* changes secondary to spleen changes.	Larger than in Banti's disease. Secondary to spleen. *No ascites.*	..	..
Prognosis.	Fatal. Shorter course than Gaucher's disease.	*Average duration,* 18 *to* 20 *years.* Death from intercurrent disease.	..	..

such conditions as Hodgkin's disease, sarcoma, and heart disease, with congestive enlargement of the spleen, may be definitely excluded from the diagnosis. With almost equal assurance waxy disease and syphilitic enlargement of liver and spleen may be excluded. It is unnecessary to say more regarding them. Malaria and kala-azar were excluded—the former by the examination of the blood, and the latter by the course of the disease. The case was obviously not one of obstructive jaundice, as the stools were not even slightly decolourised and the urine contained no bile-pigment. Again, there was no pruritus, bradycardia, drowsiness, nor loss of flesh, such as occur in many lesions affecting the integrity of the bile ducts. For similar and other special reasons hypertrophic cirrhosis of the liver differs from my case.

It was also easy to exclude leucocythæmia from the diagnosis, and because of the jaundice and the absence of myelocytes, it was not leucanæmia, the jaundice was clearly of the hæmatogenous type. The circumstances in which this condition may be caused are varied and numerous. In many cases it is mild and escapes observation. For the adequate diagnostic consideration of the present case it is not necessary to enter into an exhaustive consideration of this part of the subject.

* The tables which I have prepared include all the diagnostic possibilities that are of importance in the case under review. Consideration of these tables impresses one with the resemblances rather than with the differences between the members of this group. It is, moreover, important to recognise that these are types linked up by a large number of atypical cases which completely obscure dividing lines. One form merges almost insensibly on either hand into others. For these reasons clinical diagnosis is sometimes a laboured step, although it is equally true that the history of the case and a brief examination of the patient will often indicate the provisional diagnosis from a number of possible ones.

The case now recorded was one of hæmolytic icterus or acholuric jaundice of the chronic acquired form — a distinctly rare condition, so far as observation in this country goes. The characters which the congenital and the acquired forms possess in common are anæmia, diminished resistance of reds, evidence

* The term "Hæmolytic Icterus" is a fairly recent addition to the many names that have been given to acholuric jaundice, and when used in the course of this contribution either the congenital (family) or the acquired form of this condition is the narrow interpretation to be made.

of increased blood destruction, enlargement of the spleen, jaundice due to bilirubinæmia, acholuria, urobilinuria, absence of symptoms indicative of any increase of bile salts in the blood, viz. no drowsiness, pruritus, or bradycardia.

So far as a study of recorded cases can show, there appears to be no fundamental difference between the two forms, but it would be most misleading to leave this part of the subject without further remark. It is of practical importance that the difference should not be underestimated.

A brief description of the two forms will show their distinguishing features.

The Congenital Form.—This is the better known because the most frequently occurring form.

The family history almost invariably gives evidence of the abnormal state in one or more sisters and brothers, sometimes also in one or several preceding generations. As many as four generations of a family have shown evidence of the typical signs. The symptoms are in a fair proportion of the cases extremely mild, as "not a few of the familial cases, who were found to present all the characteristic features of the disease, were discovered only during a systematic examination of the family" (Mackintosh, Falconer, and Anderson). The condition appears to have little tendency to shorten life. Females can bear large families with impunity.

The jaundice is persistent but subject to variations from day to day, although there may be no other obvious change in the condition of the patient. It diminishes with rest, especially at high altitudes. It increases with muscular fatigue—a point of considerable interest. As the jaundice is hæmatogenous, it is clear the destruction of red cells proceeds much more rapidly during fatigue, just as in many cases of paroxysmal hæmoglobinuria. Another interesting fact is that the jaundice is acholuric. In other words, although bilirubin can easily be demonstrated in the blood and its presence there causes jaundice, it is not excreted as such in the urine. The urine is almost always dark, of a reddish rosy tint, because of the excessive destruction of red cells. Urobilin and urobilinogen tests are almost invariably positive. The spleen is large and sometimes painful. The liver is not, or but slightly, enlarged, and it excretes bile abundantly. Intercurrent hepatic colic is not unknown; the passage of a gall-stone is, however, quite evidently secondary to the jaundice. The digestive functions and the general condition are good. Pruritus, drowsi-

ess, bradycardia, and loss of flesh are not met with, as bile salts
re not passed into the blood in hæmatogenous jaundice. The
lood-serum contains oxyhæmoglobin and bilirubin (and possibly
lso urobilinogen ?). The serum is hypertonic. The anæmia is
ioderately increased, with slight pyrexial attacks in some cases,
nd then the jaundice is also more intense. Microcytes are
ommon. There is polychromatophilia. The presence of nucleated
eds and myelocytes is evidence of medullary reaction. The red
ells show increased fragility in hypotonic solutions, as pointed
ut by Chauffard. They show diminished resistance also to toxic
erums and other poisons (Widal and Philibert). It has been
ated that free hæmolysin is not found in the serum, but a few
bservers have obtained iso-hæmolytic and iso-agglutinative sera.

The Acquired Form.—This form is much less common, although
ie first case recognised as acholuric jaundice was acquired. Its
inical characters are less sharply defined. Individual cases
iow fewer characters common to all. That the morbid cause is
ot the same in each case is generally accepted. Thus there are
ises attributed to an acute infection with streptococcus, pneumo-
occus, bacillus perfringens, etc., and others of chronic infective
rigin from syphilis, malaria, tuberculosis, etc. The disease has
upervened in the course of grave typhoid infection when the
lood gave a pure culture of Eberth's bacillus. By giving rise to
poid intoxication, bothriocephalus and ankylostoma may also
iuse hæmolytic icterus. Again, chloroform, serpent venom, and
ther exogenous poisons have been experimentally demonstrated
) be icterogenic. Endogenous poisons may act similarly as in
itestinal conditions. The yellow gum of the newly born is a
orm of acholuric jaundice. The evolution of the acquired malady
s an acute or chronic one will depend on the gravity, duration,
nd intensity of the infection or intoxication. A benign form
iay run an acute, subacute, or chronic course; the malignant
orm may be acute or chronic, in the latter form possessing some
f the characters of pernicious anæmia, and in the former recalling
i many ways grave hepatic icterus. The general condition under-
oes serious changes. The number of red blood-cells is more
iarkedly reduced than in the congenital form, attended with
gnificant signs of anæmia, viz. dyspnœa, giddiness, fatigue, and
issitude. The lesion is a severe one, even during phases of
omparative quiescence. The statement has been made that
iminished globular resistance is always more difficult to prove
i acquired cases. On the other hand, there has been greater

success in demonstrating abnormal properties in the serum. In some cases the serum has been shown to possess auto-agglutinative and auto- and iso-hæmolytic properties.

It should be noted that one or other of the characteristic signs may exceptionally be absent, viz. splenomegaly and jaundice, but I have not been able to learn whether this statement is specially applicable to the congenital or the acquired form.

From the available data, as rendered above, it would appear there is no sharp dividing line between the congenital and the acquired forms of hæmolytic icterus. The boundary between hæmolytic icterus (acholuric jaundice) and the other conditions which constantly or occasionally exhibit hæmatogenous jaundice is also ill-defined. One might gather from isolated records a series of cases to link up acquired hæmolytic icterus and pernicious anæmia, so that the record occupying the middle of the chain would resemble in an equal degree both diseases. Thus it is that sometimes hæmolysin has been demonstrated in the serum of a case of pernicious anæmia. I have seen this in one of several cases which I was permitted to examine in the wards of Sir Thomas Fraser some years ago. Other observers have already noted the occasional presence of sufficient hæmolytic activity to be demonstrable *in vitro*. Again, while the resistance of the red cells is usually increased in pernicious anæmia, occasionally their fragility is similar to that found in hæmolytic icterus. Frequently enough a degree of cholæmia is also noted. In these so-called transitional cases the examination of the blood-cells and of the colour index completes the hybrid character of the picture. Not even the colour index is a trustworthy guide; it is constantly high in pernicious anæmia, but in acquired hæmolytic icterus it may be above or below 1·0. In the case under consideration the colour index was 0·83. The morphological characters and the enumeration of the cells afforded no clue to a decision.

Gulland and Goodall make the statement "that leucopenia with relative lymphocytosis of pernicious anæmia contrasts strongly with the typical changes in acholuric jaundice." There are, however, no typical changes affecting the leucocytes in acholuric jaundice, and in the majority of case reports I have read, leucopenia and relative lymphocytosis are the commonest conditions met with. Quite truly it might be said that the age of the patient will be an aid to the diagnosis, but that is only stating the facts generally, as pernicious anæmia may exceptionally occur in the young, while hæmolytic icterus may occur at any age, the

onset tending to be exceptional at the age when pernicious anæmia most commonly occurs.

Banti's complex in its earlier stages may strongly resemble hæmolytic icterus. A distinction can, however, usually be made from the absence of normoblasts and myelocytes, as well as of true bilirubin jaundice, urobilinuria, and abdominal pain. The resistance of the red cells is also normal or approximately so.

In Banti's disease there is practically never any abdominal pain. Again, the skin does not become truly jaundiced as in the case under discussion. In Banti's disease the skin takes on a muddy discoloration — possibly a urobilin jaundice. Until the ascitic stage is reached there is no urobilinuria, according to Banti. The liver is then contracted and cirrhotic. The liver was neither large nor small in the case now being discussed. There were no hæmorrhages except infrequent epistaxis. Even in Banti's disease hæmorrhage is not an early feature, but arrives with the hepatic cirrhosis. As to the blood condition, megaloblasts were present in my case—an occurrence not found in Banti's disease. In other respects there was little to distinguish it from Banti's disease, except the very marked punctate basophilia, the polychromasia, and diminished resistance of the red cells to hypotonic salt solutions. According to Lommel, however, the osmotic resistance of the red cells does not serve to distinguish between hæmolytic icterus and Banti's disease.

Syphilitic Pseudo-Banti's Disease.—The case was distinguished from this condition by the points just alluded to, and by the entire absence of the stigmata of congenital syphilis and of any events in the family history suggesting syphilis. An opportunity for making the Wassermann test did not occur.

Primitive Endothelioma of Gaucher.—This condition frequently affects several members of a family. There is no jaundice but a brownish-yellow discoloration or pigmentation of the skin. There are no characteristic blood changes, except persistent leucopenia. Conjunctival thickening occurs. Marked enlargement of the liver is also characteristic.

With the *hæmoglobinurias* there is a close relationship, both clinically and pathologically. Whether hæmoglobinuria or merely jaundice will result from the hæmolysis depends on the briskness of the corpuscular destruction. In hæmoglobinuria there is invariably some hæmolytic jaundice, and in cases of so-called hæmolytic icterus there is sometimes hæmoglobinuria. The spleen is enlarged in both conditions. The less brisk the hæmolytic action is the

greater opportunity will be afforded the organism to retain the hæmoglobin and to transform the iron-free part into a pigment which is indistinguishable from bilirubin. The leucopenia, acholuric jaundice, and absence of enlarged lymphatic glands differentiated my case from the common secondary anæmia of children.

Splenic Anæmia of Infants (*von Jaksch*).—Cases may occur in which the diagnosis will not be easy. The age, the leucopenia, with definite acholuric jaundice were sufficient alone to exclude this disease.

Vaquez's Disease.—Although this disease is entirely different in its pathology and main characters, it possesses in common with hæmolytic icterus the enlargement of the spleen and augmentation of hæmolytic phenomena. In consequence of this a certain amount of hæmolytic icterus is present in some cases. These phenomena are secondary to the bone-marrow hyperactivity and indicate an endeavour to grapple with the resulting polycythæmia.

Tuberculosis of Spleen.—A primary isolated tuberculous lesion of the spleen is not diagnosable with certainty except after operation. Recorded cases number well under fifty, and in only one have I found that diagnosis was made before operation. What one has been able to gather from the scant literature is, that the blood examination differs from other splenic anæmias. In my case the only slightly suggestive fact was the positive von Pirquet reaction.

Having excluded the possibility that the diagnosis can be other than hæmolytic icterus, the only matter left to determine is whether the case is acquired or congenital. The reasons for believing the case is of the acquired variety are—the jaundice did not occur till many years after birth, the spleen apparently did not become enlarged till many years after birth, the patient's health has been more seriously affected than is usual in the congenital variety, and the abdominal pain has been much more disabling, there is no family history of the disease, and, finally, the first symptoms of the disease followed upon a severe illness in the joints and chest.

Historical Survey.—It appears that in 1710 Bianchi distinguished between the two types of jaundice. The next step was taken when Virchow identified the yellow pigment of old hæmorrhagic lesions with bilirubin. Then Hoppe Seyler transformed hæmatin into urobilin, while Maly obtained urobilin from bilirubin. There was thus an intimate relationship between the colouring matter of the blood and the bile. Again, numerous hæmolytic agents produce sometimes jaundice, sometimes hæmoglobinuria or at least hæmoglobinæmia.

Leyden, in 1866, differentiated hæmatogenous jaundice from hepatogenous by the absence of biliary salts in the urine of the former. In France the condition became known as *hæmapheic* icterus, while in Germany it was years later named urobilinuric icterus. Hayem gave to it the name metapigmentary jaundice as distinguished from orthopigmentary jaundice, because the pigment appeared in the urine as urobilin or urobilinogen and not as bilirubin. Hence also the names acholuric or, more exactly, abilirubinuric jaundice. This is the fundamental characteristic of the family Cholæmia of Gilbert (1900-1901). At the same time, Minkowski described "Hereditary Splenomegaly with Chronic Icterus." In 1904 Leuret attributed jaundice in the new-born to hæmolytic properties of the blood, and, finally, Chauffard gave the name hæmolytic icterus, and attributed the pathogeny to a diminished resistance of the red corpuscles. A little later Widal investigated the blood on lines which had previously been carried out in investigations on paroxysmal hæmoglobinuria.

Pathology of Hæmolytic Icterus.—The hæmolytic jaundice develops itself in two stages—I. Hæmolysis; II. Transformation of the free hæmoglobin into biliary pigments.

I. *Hæmolysis.*—How and where does the hæmolysis take place? From the published investigations one might very readily believe there are two types of hæmolytic icterus—one with fragile corpuscles and the other with hæmolysin in the serum.

It is possible the fragility is not primary but caused by the sensitisation of red cells by a hæmolytic amboceptor, as in paroxysmal hæmoglobinuria. The evolution of this sensitisation has been followed in the sanguineous pleural effusions by Gullain and Troisier. At first the red cells resist normally, and the hæmolysin is free. Little by little the hæmolysin disappears, and the cells become more fragile. Analogous facts have been observed more rarely in the blood.

As already stated, however, Widal believes there is a primary dystrophy of the red cell. He believes the congenitally weak cells are destroyed in the circulation, and their remains taken up by the spleen, causing an enlargement of the organ, and by the liver, kidney, and bone-marrow. The chief objection to this theory is that it completely ignores the great improvement following splenectomy. Minkowski appears to have been the first to suggest a primary increased hæmolytic activity of the spleen as the source of the malady. Banti believes the spleen is not only a reservoir for waste material but actively destroys increased numbers of cells.

On the other hand, it has not been possible to demonstrate hæmolysis by the normal spleen.

II. *Transformation of Free Hæmoglobin into Bile-Pigment.*—There is an increased amount of hæmoglobin to be got rid of, and in the past most authorities have believed that the liver converted this into excessive amounts of bile, viscid and highly pigmented, causing clogging of the bile capillaries, absorption of bile by the blood, and jaundice. The hypothesis was that the increased tension within the bile capillaries leads to the passage of bile into the blood. Whipple has shown there is another possibility, viz. that bilirubin can be formed by the endothelium of the blood-vessels entirely isolated from the hepatic circulation. It is known, moreover, that bile salts are not circulating in increased quantities by the absence of the usual signs—bradycardia, itching, drowsiness, and loss of weight. Again, if the tension were so increased as the result of clogging, viscidity, etc., it is certain that there would be more frequent clinical evidence of various functional disturbances of the liver.

Another of the many interesting questions regarding the jaundice that still require elucidation is the absence of bile-pigments in the urine when it is abundantly present in the blood.

Treatment.—One of the two chief motives for bringing the patient to Scotland was to obtain an opinion regarding treatment, and for this reason the patient was brought to the Royal Infirmary, Edinburgh. To discuss this subject fully would occupy too much space. Stated briefly, the question requiring an answer was whether it was best to recommend or advise against splenectomy in this case. In many of the acquired cases a definite opinion ought to be expressed owing to the urgency of the patient's need of an effective treatment. In other cases of this type there may be no urgency and the physician may watch and wait. In all cases when urgency does not compel the immediate resort to operation it will be necessary to assess the relative risks of splenectomy and of waiting and to state these clearly to the patient or guardian. That was done in the case above recorded. The mother elected to wait, and before she left Scotland she wrote to inform me that her son was in better health than he had experienced since the onset of his illness.

Literature.—Kindberg and May, *Arch. de Méd.*, 1912, t. xxiv. No. 2. Chauffard, *Ann. de Méd.*, January 1914. Roch, *Rev. méd. de la Suisse Romande*, 1914, an. xxxiv. No. 3. Senator u. Krause, *Berl. klin. Wochenschr.*, 3rd July 1911. Mandelbaum, *Journ. of Exp. Med.*, New York, 1912, xvi. Brill and Mandelbaum, *Amer. Journ. of Med. Sci.*, December 1913.

THE TRAINING OF THE STUDENT OF MEDICINE:

An Inquiry Conducted under the Auspices of the Edinburgh Pathological Club.

V.—THE TEACHING OF ANATOMY.

By Professor G. ELLIOT SMITH, Manchester.

In every field of human activity there is a tendency, once a procedure has been devised that gives satisfactory results under the conditions then prevailing, for the methods to become stereotyped and handed on by tradition to other times and generations of students, the respective conditions and needs of which are not the same. If we are to guard against this insidious influence, which in every field of endeavour is fruitful of waste and misdirection of energy, we must from time to time take stock of our methods and ask ourselves whether they are really those best adapted to meet the needs of the ever-changing circumstances.

In so venerable a subject as anatomy there has been ample time for the hampering influences of tradition to develop; and the danger from them is much more serious than in the case of many of the newer subjects of the medical curriculum, which have been immune from the risks of such conventionalisation as is inseparable from old age. Anatomy has not responded—perhaps, it will be claimed, solely because there has been no need for it to respond—so rapidly and completely as, say, such a mushroom growth as pathology, in adaptation to the altering needs of the time.

Two main criticisms of a general nature must be brought against the teaching of anatomy in most British schools. First, there is the extreme narrowness of the conception that all the anatomist has to teach his students is the dissection of the dead body, and by means of a prolonged series of lectures to reiterate the same mass of information in another way, perhaps with a few tags of embryology. Secondly, there is the method by which such teaching is conveyed to him—the dreary systematic lectures, the absence of any real attempt to explain the meaning of the structure of the body, its physiological significance, and its relation to the problems of the pathologist and the clinician.

Anatomy should be regarded as an integral and intimately co-ordinated part of the whole medical course, and it should be the business of the teacher to give expression to this broad view in his teaching. How, for example, is it possible to convey to the student any intelligible account of the central nervous system without dis-

cussing the meaning and the functions of the various arrangements of neurones and describing what happens when injury or disease interferes with their connections? What a hopeless and incomprehensible maze the cerebellum, the sensory tracts, and the connections of the red nucleus are when stripped of these functional explanations. But if they are discussed with the help of physiological and clinical data they become simple, intelligible, interesting and arresting, and hence easily remembered. In every department of anatomy the same method can be used with advantage. By so doing, the teacher is not merely giving the student a broader and more practical knowledge, but he is conveying to him the kind of information which appeals to his interest and can be remembered because it has some meaning. No longer is it a case of learning by rote his way through a confused labyrinth of meaningless facts, but it becomes an appeal to his intelligence to realise their meaning, and so, by comprehending their purpose, the student has a reason for remembering.

In a discussion of the teaching of anatomy it is essential that we keep our aim constantly in view—it is to convey to the student within a strictly limited period of time an intimate acquaintance with the structure and meaning of the *living* human body. Though most of the student's knowledge is acquired by the dissection of the corpses of more or less senile wrecks of humanity, it should not be forgotten that his primary aim is to learn the geography of the living bodies of men and women. It is vitally important that at every stage of his investigation of the corpse he should be forced to picture to himself, and, so far as possible, to study on the living body—by the examination of the surface anatomy of living models, by the use of X-rays, or by the study of results of disease—what significance the facts have in the active living body. The student of anatomy is learning the geography of the territory in which all his work as a practitioner will be conducted, but he must never be allowed to forget for one moment that his aim is to understand the living body and not merely a corpse.

Though the time spent by the student in the dissecting-room is now cut down to the irreducible minimum, it is still sufficient to enable him to examine in detail every part of the body. In spite of anything that may be urged against this course, it is vitally important that nothing should be allowed to stand in the way of this essential training of eye and touch to become thoroughly familiar with the arrangement of every part of the body. Whether the student remembers all the names or can write an account of all that he has seen or handled is of secondary importance. The primary value of dissection to the student is to enable him to find his way about the body. Much of the knowledge he acquires is of a subconscious nature, but is none the less real on that account. By a limited experience I have learned

to find my way from Princes Street to the University, but I cannot name a single street or landmark, nor give more than the vaguest description of the route; yet I have the essential knowledge which meets my needs. The vital knowledge of anatomy that it is essential for the student to acquire is of a similar nature. Those practitioners who boast of their lack of anatomical knowledge, simply because they cannot name many of the landmarks which guide them, forget that the information they rely upon was equally (with the terms they have forgotten) acquired in the course of dissection, and is the sort of knowledge with which the study of anatomy should primarily aim at supplying the student. But the teaching of anatomy should aim not merely at familiarising the student with the geography of the body; it also should enable him to learn to appreciate the meaning of its structure, to understand the factors which regulate its growth and development, which determine its form and explain its anomalies —in a word, the student should be made to understand the living organism with whose working all his professional work is concerned.

In all studies the greatest incentive to the acquisition of knowledge is interest. The student of anatomy in practically every instance is looking forward to the profession of medicine. In commencing the study of anatomy he is getting the first glimpse of the promised land. He feels that he is really beginning professional work when he takes the scalpel in hand and begins to explore the human body. How is this enthusiasm to be cultivated and encouraged? Is it wise to kill this plant of tender growth by the daily drudgery of lectures on bones, extending over weeks and months, until the mere sight of a bone is sufficient to excite the suppression of all interest in it? The student who knows nothing of medicine or surgery is yet keenly interested in all that pertains to the work of his profession. The use of facts of clinical medicine and surgery, of pathology and physiology, to illuminate the significance of anatomical data is an invaluable adhesive. By appealing to his interest by such demonstrations, anatomical information and its meaning can be impressed upon his memory.

It must not be supposed that I am claiming to make the anatomy lecture-room the place of instruction in physiology, pathology, medicine, and surgery. All that I am asking is that the various branches of medical study should not be regarded as strict preserves, enclosed in water-tight compartments; and that it should be the duty of the teacher of anatomy to have recourse to every kind of device which will help to impress upon his students' minds the facts of anatomy and their meaning, irrespective of whether they belong to his own province, or those of the zoologist, the embryologist, the histologist, the physiologist, the pathologist, or the clinician.

If the exhibition of a patient with compensatory distension of the

superficial veins of the abdomen will impress upon the mind of the student the anatomy of the portal anastomoses, the anatomist ought not to hesitate to use such a patient for this purpose—not to pretend to teach medicine, but to interest the student and so impress anatomical facts upon his mind.

Lectures on Anatomy.—A fortnight ago anatomy suffered a grievous loss by the death, in the prime of his powers and influence, of Franklin Mall, who revolutionised the teaching of anatomy in America, and was in larger measure than anyone else the inspiration of the marvellous progress of anatomical research there. One of his reforms was the practical abolition of lectures as a means of teaching anatomy. Is this an example to follow? I agree with Mall to this extent, that, taking into consideration the limited amount of time of the student and the excellence of the text-books now at his disposal, the attempt to deliver a systematic course of lectures is wholly indefensible; it is a waste of precious time which can be more usefully employed in other ways. But I refuse to admit that lectures do not serve a very useful, if not invaluable, means of instruction.

Instead, however, of employing the time in expounding to the student information which he can more usefully acquire in the dissecting-room or in the study of his text-book, the teacher should make it his business in the lectures to deal with aspects of anatomy which the student is unable adequately to learn in the ordinary work of the dissecting-room, such, for example, as the lymphatic system, certain parts of the nervous system—for instance, the clinically important but much neglected sympathetic system—and the anatomy of the viscera.

Lectures should be devoted also to the business of linking up the knowledge of the structure of the body and its meaning, which is acquired practically in scattered fragments, and in emphasising points of outstanding importance and so giving the student a right perspective.

In this country there is far too much spoon-feeding. The student should be required to find things by his own unaided efforts—to be allowed to get into difficulties and find his way out. This teaches him observation and impresses the essential facts of anatomy on his mind in a way which does not occur when he constantly has a demonstrator at his elbow to save him any mental exertion.

But in saying this I do not mean to imply that our anatomy departments are overstaffed. We need much larger staffs than we command at present, but they should consist of men or women who are really working at anatomy and are competent to provide the student with first-hand information and to train him to observe.

It is important that demonstrators should have ample leisure in which to carry on serious research. No man can be a really efficient and stimulating teacher unless his own mind is kept constantly alert by original investigation. Unless this is so he is merely a purveyor of

second-hand goods. He may, no doubt, be very efficient in cramming men for examinations; but if he himself is not interested in the acquirement of first-hand knowledge, he must, of necessity, fail to stimulate in others the interest which is the essential incentive to real observation, and is at the root of all real training.

The man who is actually engaged in research, and can give the student first-hand information, can also describe from his own experience the difficulties that have to be overcome and the way progress is actually achieved. The investigator, who can, by his example, demonstrate to the student that real learning can be acquired only by individual effort and research, has at his disposal the most powerful instrument, not merely of stimulating students to acquire true, and not second-hand, knowledge, but also of firing them with the zeal to learn from their own observations and to trust their own judgment. This is the secret of all real success in the practice of medicine. Clinical work is, in the truest sense of the term, original research, and the anatomy rooms are the place where confidence in his powers of observation and reliance in his own judgment should be instilled into the student's mind.

These views may be trite and threadbare, but, in spite of age-long lip-service to them, they are still sadly neglected. The text-books of anatomy would not be so full of traditional errors if students and teachers could be taught to trust their eyes. The discipline of anatomy should thus teach students to rely on their own judgment. But it can achieve this important aim only if the student's attention is kept constantly alert and his interest excited by considering the why and the wherefore of everything he sees and feels in the course of his practical work.

Osteology.—In former times, when the supply of material for dissection was even more precarious than it is now, the study of anatomy came to be based essentially on the examination of the skeleton. The student was lectured *ad nauseam* on bones; he was encouraged to devote himself to acquiring an intimate knowledge of this framework of the body, upon which he could subsequently hang such tit-bits of information concerning the soft parts as he was able to pick up later. The phrase "dry bones" became a byword for dulness and lifelessness, and all that was dreary in the way of acquiring knowledge. It became the highest encomium upon a teacher's abilities that "he was able to make the dry bones live." This wicked and sterilising farce is still enacted in many schools. The antiquated tradition of the osteology class is still permitted to waste the student's time and kill his natural interest in the subject of anatomy.

The bones are as much a part of the body as the muscles, the blood-vessels, and the nerves, and they ought to be studied in the same way, *i.e.* in the dissecting-room. There the factors that determine the form

and the markings of bones should be studied by direct observation, instead of being learned by rote from the statements of a text-book or a lecturer. If the student is required to study the skeleton in this way he will not only acquire a sounder and a truer knowledge of it, and in a much less tedious way, but he will get the sort of information that is practically serviceable. Moreover, he will learn by observation and acquire knowledge which is much less evanescent than the artificial collection of data crammed from books.

In the introductory course of lectures the student should be taught the nature and the mode of development of bones, the kind of knowledge he will have to acquire, and how this can be accomplished in the course of his dissections. When this has been impressed upon him and care taken to insist that he really studies the skeleton in the course of his dissection, the student, freed from the depressing tedium of the osteology class and convinced of the futility of burning the midnight oil over dry bones apart from the body, will acquire a much more proficient knowledge of osteology than the antiquated method gives him.

Such a method will also give him a better perspective in the study of individual parts of the skeleton. Why, for example, should it be a practice artificially to wrench asunder the constituent bones of the skull, to multiply difficulties for the student, to make him learn hosts of useless details, and distract his attention from the articulated skull with which he really has to deal in practical surgery and medicine?

Looking back to my own student days, when, full of enthusiasm for the subject, I first began anatomy and sat at the feet of one of the most clear-sighted and inspiring teachers, I have the most vivid recollection of the manner in which those first two terms of osteology rapidly killed all interest in the subject. It was not merely that I ceased to learn anything from the lectures, but a positive and intense repugnance to the business of acquiring a knowledge of the bones took possession of me.

In the light of this experience, when I took over the control of a department of anatomy, I gradually eliminated the osteology course, to the mutual advantage both of the students and teacher.

Course of Instruction.—Now let me attempt to sketch out a scheme for allotting the limited amount of time the student is allowed for anatomy.

During his first term the student should be required to dissect a limb, preferably the arm; he should be compelled to do the work thoroughly, to learn his technique, and to use and care for his instruments. It is of the utmost importance that from the outset he should be trained to correlate all the facts which he learns from dissection with such knowledge as he can acquire from the study of the living arm, both upon himself and a model. He should familiarise himself with every detail of the surface anatomy of the living limb, and the

changes produced by the action of muscles. This should be a matter of constant study at every stage of the dissection, and not be relegated to some other time when the whole dissection is completed. It should be his business closely to correlate and integrate all kinds of knowledge of bones, muscles, vessels, etc., with that relating to the form of the living limb, and this can be done efficiently only when the student is actually examining the structures which are to be correlated with the surface anatomy. Facilities should also be given him at the same time to learn from X-ray photographs and also how to interpret them.

In the introductory course, which in Manchester consists of thirty lectures, I attempt to give the student a general survey of the scope and methods of anatomy, an account of the outstanding features in the developmental history of the human body, and the factors which regulate its growth and determine its form and size. In this course a general view of the structure of the human body is presented to the student, with an account of the metabolic factors involved in the assumption of the secondary sexual characters, the phenomena of heredity, the variability of structure and its significance.

After each lecture the student devotes two hours to the practical study of the histology of the structures dealt with in the lectures, such as the sexual glands, Graafian follicles and corpora lutea, the uterus and Fallopian tubes, the placenta; and a detailed examination day by day of the sections of a third-month human embryo, which familiarises the student with the general anatomy of the whole body, and gives what is really a diagrammatic idea of the histology of the organs and tissues.

The value of such an introductory course is difficult to over-estimate. The student not only gets a wide view of the whole subject and its problems and the method of study, but even the dullest in the class is stimulated to take an interest in anatomy and to learn to be observant.

If this first term's work has been consistently carried out, the student is fairly launched on his course, fully equipped to carry on his practical work without much help, and keenly alert to understand the meaning of the structures he is dissecting.

It is necessary for the teacher constantly to impress upon him the importance of the surface anatomy of the living body and of the study of the functions of the arrangements of parts. The lecture courses in the next four terms deal with the lymphatic and nervous systems, the pelvis, and the abdominal and thoracic viscera; they are intended to supplement the studies in the dissecting-room and to co-ordinate the information so acquired with that provided in the embryological and histological classes. I hope very soon to be able to start practical courses of instruction in the histology of the organs of the *human* body, for in teaching anatomy it is essential that the structure of the body should be studied as completely and as practically as possible.

The student should be provided in the anatomy department with such information and training as will enable him to proceed directly to the task of studying morbid anatomy and histology in the department of pathology. At present this is not the case. Not only is the borderline between macroscopic and microscopic anatomy almost wholly neglected, but also the histology, especially of *human* tissues and organs. It is essential that the student should be thoroughly trained in these matters, and this can be brought about only when the anatomists assume control of the teaching of the whole anatomy of the body, whether this is seen with the naked eye, through a lens, or a microscope.

ANATOMY AS THE FOUNDATION OF MEDICAL EDUCATION.—One of the most important functions of teaching is not merely to give the student a clear insight into the intrinsic merits of the subject, but also—and this is of fundamental importance in any course of professional instruction—to prepare him for those special applications of the subject, in physiology and pathology, in surgery and medicine. The teaching, in other words, should be directed towards the needs of the practice of medicine; and it should be the business of the teacher of anatomy to keep sufficiently in touch with the progress of medicine as a whole to direct his teaching toward the right aim.

The development of abdominal surgery, for example, called for a more or less complete reorientation of the anatomists' teaching. So in every branch the anatomist should keep in view the special needs of the practitioner and emphasise those kinds of knowledge which have direct practical importance.

If anatomy is thus taught as an integral and vital part of the medical curriculum, closely co-ordinated with the rest of the course, the student will acquire the habit of returning to the dissecting-room from time to time throughout the rest of his course to seek the solid foundation of fact when in difficulty. Thus anatomy will become once more the real basis of medical education.

The practice of requiring fifth-year students to attend a course of clinical anatomy, given by an anatomist in the department of anatomy, has played an important part in the development of this co-ordination between anatomy and medicine. This system has now been in practice in Manchester for eight years, and it is a step towards the more intimate integration of anatomy with every part of the medical course. Incidentally it helps us in the anatomy department to keep in closer association with the clinical point of view.

The student of medicine must be taught to think anatomically; and this can happen only if from the day he begins the study of anatomy he is constantly impressed with the idea that he has to deal with the living body, and that lines of demarcation between anatomy and physiology, pathology, and clinical work are merely arbitrary and not barriers against a free exchange of ideas.

VI.—THE TEACHING OF ANATOMY.

By DAVID WATERSTON, M.D., F.R.C.S.E., Bute Professor of Anatomy, St. Andrews University.

I UNDERSTAND from the secretary that my part in this conference is to give you the views which I hold upon improvements that may be effected in the teaching of anatomy in the medical curriculum, as a part of a general scheme for the improvement of medical education. I willingly raise my voice for such an object, for the present conditions are in many respects unsatisfactory. They bear with special weight upon the anatomical teacher, who often feels how impossible it is for him adequately to carry out his share in the medical curriculum from the inadequate time afforded to him, as well as for other reasons.

Probably I need hardly devote any time to proving to you how difficult it is to carry out our work satisfactorily under the present conditions, but I am firmly convinced that it is as a direct result of insufficient anatomy that the education of the medical student in other subjects of the medical curriculum so often fails.

Before we can draw up a plan for our guidance, it is essential that we have a clear idea of the position of anatomy in the curriculum, of its relation to the other subjects, and of the aims of the teacher of anatomy in planning his courses.

I am not quite sure that an audience such as I am addressing, composed largely of specialists, is the one best fitted to judge of the relation of anatomy to the work of the general practitioner, and of what should be our aims in training students who, for the very great part, will be general practitioners, but yet I feel that you must be sympathetic to the subject; for the first step in your own specialisation probably began with, and certainly has included, an independent, fresh, and complete study of the detailed structure of the organs or region of the body in which you are specially interested, whether it be the eye, the ear, nose and throat, gynecology, mental diseases, or even dermatology. And I expect that most of you have not found it sufficient to study the structure of the adult organs only, but you have found that in order to understand the anatomy and pathology of the fully formed organ it was necessary to look minutely into the successive stages of its development. And conversely, I am sure that the examination of large numbers of cases of diseases of the region has often thrown new and valuable light upon problems of structure which were formerly unnoticed or obscure. Now, if such a training is the first step in the education of the specialist, it embodies in miniature something of what we require for the general practitioner. And the general practitioner is even more dependent than the specialist upon a knowledge of anatomy, insomuch as his diagnosis so frequently rests upon informa-

tion obtained from an examination of the patient by touch and by inspection only, and apart from the special aids which the laboratory and the consulting-room can afford.

The very basis of the ordinary physical examination by a practitioner rests primarily upon his familiarity with the normal anatomy of the human body. I am in entire accordance with the views of an eminent surgeon in Edinburgh, whose name would carry very great weight with you, who has told me that his experience has been that he sees more cases of errors in diagnosis and in treatment which have arisen from defective knowledge of anatomy than from any other cause.

My recent experiences of service as resident surgeon or as surgeon, with the accompanying contact with young graduates, not only of our own school but of all the Scottish universities in the intimate relationship of colleagues in the same war hospitals, opened my eyes to the handicap, with which so many of them were contending, of an imperfect and inadequate knowledge of the structure of the human body, a handicap which they were the first to realise and to acknowledge, and which they were for the most part keenly anxious to overcome.

But while a comprehensive minute knowledge of anatomy is of the greatest value in practical work, such a knowledge is not generally attainable, for the detailed study of the structure and development of the human body is not a study only of months or of years, it can last a life-time, and the problem before us is to make the best use of the limited time at our disposal.

The fundamental aim of the anatomist is the investigation of the structure of the body as a whole and of its parts in relation to the activities which they individually and collectively exhibit at all periods of the cycle of development and in response to the external forces which act upon them.

It has been pointed out that in the medical curriculum anatomy occupies a central position, its scope overlaps physiology, pathology, zoology, and psychology, and we cannot separate anatomy from any of these by any arbitrary line. Its scope, however, is limited from the fact that these subjects, mainly originating in anatomy, have now become separate and independent subjects, but their very roots still draw nourishment from the fruitful field of human anatomy.

Close association with the purely technical aspects of medicine and of surgery have also tended to narrow the scope of the subject in so far as they have tended to look upon anatomy merely as an aid to established procedure.

The purely morphological conception of anatomy as illustrated in our text-books retains little of the former animating idea of function, which alone can impart to the subject a vital interest. Certain little scraps still remain as vestiges of the former wider outlook of anatomy, such, for example, as the chemical analysis of the composition of bone

tissue, which is still found in current text-books, and is the only scrap of chemical analysis retained.

From the functional standpoint, anatomy has been robbed of almost every portion of its heritage except, perhaps, the grosser mechanical action of the muscles, the function of the valves of the heart, of the functional distinction between the roots of the spinal nerves, and the function of the motor areas of the cerebral cortex.

Within recent years, however, there has been a reaction against this condition of affairs, and against the view which would make anatomy merely a morphological study of the dead body.

The study of the living model, and the general use of X-rays to illustrate structure as found in the living, form two examples of this newer attitude, and anatomical work on the structure of the heart from the standpoint of function has been applied so as to revolutionise our conceptions of the physiology and pathology of that organ. The stirrings of this newer spirit will, I am sure, soon make their influence felt in bringing about many alterations in our attitude to the phenomena of disease.

The practical task of the anatomist in dealing with his students is, in the first place, to imbue them with the spirit of investigation of structure in relation to function, and, in the second place, to ensure that, as they pass through his hands, the students acquire a competent knowledge of the structure of the body. In both of these directions his task is a long and arduous one. The raw material upon which he has to work consists of a mixed mass of men and women, the majority of whom are indifferently educated, with wide variations in their intellectual capacities and ideals, and knowing nothing of the structure of their own bodies. Anatomy forms, in the majority of cases, the gateway through which a flood of new ideas comes in.

At present in the Scottish universities the curriculum in anatomy nominally extends over two years, though the student's attention in the first year is so much taken up with the preliminary scientific subjects that it is of little value to the anatomist. During that time attendance is required upon a course of systematic lectures, given by the head of the department, which forms an introduction to the subject.

In the second year only optional courses of instruction are provided, but attendance upon courses dealing with topographical anatomy is general. During the two years dissection is carried on. Later in the course, in some schools, an optional course of anatomy in its relation to surgery and medicine is given, and the course of "operative surgery" constitutes a useful review of anatomy of portions, at least, of the whole body.

It is, in some respects, unfortunate that the course in anatomy has to precede hospital work; when in contact with the problems

of injuries and diseases the student comes to appreciate the a thorough knowledge of structure as an equipment for dea... these problems, and the stimulus and interest so created come too late to be of any use to the anatomist. But yet most students have no lack of interest in the subject, and the essential preliminary work in anatomy fully occupies the time available at this stage.

The terms alone used in anatomy are so numerous as to form a new vocabulary, which cannot be acquired in a short time. In the first year there appears to me to be room for great improvement. During it, at present, the student's education is being carried on in subjects which properly are introductory to anatomy and should not run concurrently with it, and anatomy cannot be, and is not, satisfactorily studied until this preliminary work in zoology, physics, and elementary chemistry has been completed. Botany should, I think, be transferred from the medical curriculum to the preliminary examination, for it is a subject which can be taught in schools to the stage that is necessary for medical students with great advantage.

I would suggest that after the completion of the preliminary scientific courses two years should be given to anatomy and for part of that time to physiology and pharmacology, and the student should also continue his work in chemistry.

As practical means of education we have the combination of the methods of "lecture-demonstrations" and practical laboratory work. From my own experience I am convinced of the value of well-illustrated lecture-demonstrations, and we cannot dispense with them. I am sure also that the custom of a daily lecture during the whole term is a mistake and is too frequent, both for the student and the teacher. Such lecture-demonstrations consist of two main groups, first of a series which are introductory to the practical study of the subject, in which the general structure of the body is illustrated and the structure and the function of the various tissues and systems are explained.

In my own course I find it is useful to deal with the subject of osteology, not as a mere description of the dried bones, but to explain fully the differences which exist between a dried and macerated bone on the one hand, and a living bone as it exists within the body at different stages. This raises at once problems of embryology, of the mechanism of growth, of internally secreting glands, of experimental methods for approaching the solution of problems of structure, and so forth. Then the limb skeleton, including the ligaments and joints, are briefly described from the standpoint of an examination of the physics and dynamics of a physical mechanism. Later on, the functional structure of some of the simpler systems is studied. X-rays and lantern and microscopic projection form an indispensable assistance in a course of this kind. To the individual teacher may safely be left

the arrangement of a course on the lines I have indicated, and I do not consider it necessary to go into fuller details.

In a later part of the course the students gain great assistance from a course of topographical anatomy, in which the actual dissections are for the greater part done in front of the class by the lecturer. Such a course follows the student's own dissection of the region dealt with, and in no sense replaces his own practical work.

The lines on which the student's practical laboratory work is to be carried out require the most careful attention, and no unnecessary difficulties, such as overcrowding, bad lighting, or ventilation should be allowed to exist. Anatomical laboratories have in the past been starved in personnel and in equipment. Dissection is an introduction to surgical practical work, and it should be used to train the student in habits of neatness, cleanliness, and order.

I have not referred to the part which embryology and anthropology should take in the student's training in anatomy. In them are represented the principal lines along which anatomy, as a science, is advancing. Embryology is particularly important as a branch of the medical curriculum, not only from the help which it gives in explaining rationally the details of adult anatomy, but also from the conception it provides of the human body as, in each individual, a developing and changing organism. These two subjects form a part of the necessary "science" equipment of a department of anatomy, and will probably come to have an even larger bearing than at present on the problems of practical medicine.

Nor have I discussed the question of the teaching of practical histology in the department of anatomy. No arbitrary line can be drawn in terms of the visual enlargement employed in the study of structure, and the microscope is essentially an instrument of the anatomist. His teaching cannot but deal with minute structure, and it would seem to be only logical that he should give the whole teaching required in that subject.

I am quite sure that a medical school does not obtain the full benefit from its department of anatomy unless that department can be made use of to a much greater extent than merely up to the end of the second or third year of the student's education. Its bearing upon the clinical studies arises fully only in the later years of the curriculum, and means should be provided for bringing the students and teachers of these subjects into contact with the department of anatomy by the provision of special lecture-demonstrations on applied aspects of anatomy during the later years. Courses on such subjects as the anatomy of the central nervous system and organs of special sense, as well as applied surgical and medical anatomy, should be given within the anatomy department by some of the younger specialists on these subjects, as an introduction to the clinical special courses

Lastly, I would venture to urge very strongly a modification of the present system of professional examinations, with a view to substituting for them in their present form a consideration of the record of a student's work during his whole course. Such a record forms a better ground for judging of his knowledge of the subject than the present test. This, however, is rather apart from the main subject of this paper, and I would only say that I am sure that a change of this kind would react most favourably upon the standard of work which is attained at present.

VII.—THE PLACE OF ANATOMY IN THE MEDICAL CURRICULUM.

By Professor ROBINSON.

Anatomy as an independent practical science and as a fundamental science requires for its proper pursuit an adequate amount of time and an adequate provision of facilities. To my mind, training in anatomy should not cease when a man leaves the anatomy rooms and goes to the hospital; the necessity should be laid upon him of undertaking additional work in anatomy following the lines of the special work he is doing in the hospital. Perhaps it would clear the ground if I told you in the first place what we in the anatomy department try to do, and, in the second place, what we would like to have done.

You must understand clearly that what I am going to say about what we do does not necessarily apply to this year or to the years of the war, because, owing to lack of staff, we cannot follow the course we pursued before the war. You all know how much time is allowed to us. A student commences anatomy as soon as he enters the university, and by the end of his second year, therefore, it has been possible for him to have six terms at the subject—perhaps even seven, according to the time he enters. The regulations are that he shall attend one course of lectures and have five terms of practical work. I shall deal with the lectures first.

The *lectures* are given in the first winter, when the man knows nothing about anatomy. I cannot give you a syllabus of them, because they are never the same in any two years, although they follow a general plan, the aim being to show generally what man's place in Nature is. Later we point out to the student that man is an organism, and that the organs he possesses are arranged in definite systems, and we tell him what the purposes of these systems are. Afterwards we go on to show the topographic relations of each system with every other. When this ground has been covered—or sometimes before—the student gets a general sketch of human development, up to the formation of layers and the further elaboration of layers into tissues. Then, if there is

time, he gets a fairly full account of something he cannot follow very well in the dissecting-room in one system, say, the central nervous system. Its relations to medicine and surgery are pointed out. I find that to go over the work I have specified takes all the time at my disposal—indeed it never gets fully accomplished.

There are no tutorial classes in association with the lectures now.

With regard to *practical anatomy*. The student, as I said, has five terms of it, and in that time he has to dissect the body—one part in each term. A good student might possibly be able to do more than that in connection with certain parts, but if he could, we could not give him the material, unless we were to poach upon that ready for next term's work. Thus in five terms he takes the body to pieces more or less satisfactorily *once*. After that he has a term—provided that he has not been thrown back by bad work—in which he can work as he likes and revise his knowledge in order to bring it up to the point necessary for examination. In addition to the practical work, and in association with it, there is for junior students a series of tutorial classes on bones. This tutorial instruction refers to the practical work only, not to the lectures at all. For second-year students there is a series of demonstrations, which are not, however, compulsory, and in association with this subsidiary tutorial classes are arranged, so that a man can, if he likes, in his last term revise quickly, at any rate, the essential parts of the body.

His knowledge, as gained from the lectures, practical classes, and demonstrations, is tested in a series of examinations—in the first place in the dissecting-room. When we have our proper staff, students are divided up into groups of not more than thirty if possible. Each group is under one demonstrator, who is responsible for supervising individually his group during its hours of compulsory practical work, viz. six hours a week for the first summer, and for the rest of the time ten hours a week, plus as much more as possible. The demonstrator has to give a report of each student, with his opinion as to the man's capabilities and whether he does his work satisfactorily. This report is again supervised, and finally entered into our book, where we keep a record of the whole work of each student from the time he comes to us to the time he leaves.

The student has three examinations in connection with the lectures—none of them very difficult—which help him to focus what he has learned in the two lecture terms. In connection with his practical work he has to pass first of all three examinations, on each part he dissects, under different demonstrators, with a final examination on the whole. If these show unsatisfactory work, he is sent back to revise. Thus he gets during his five terms twenty examinations on his parts. He has in addition, on his demonstrations, which he takes in two terms, four examinations, each of which consists of three parts—a written,

a *vivâ voce*—always on surface anatomy—and an examination upon the parts which have been dissected—good parts, carefully dissected, and in which the organs are easy to recognise if the student knows his work. As a result of all these examinations, we can tell quite readily who should pass and who should not in the professional, and I may say that on this basis there would be a far larger number of rejections than actually occurs. A good many get through—and rightly too—owing to the fact that after leaving the regular class instruction they have a term before going up for the professional examination in which they can focus their knowledge and successfully pull up their work to satisfy the external examiner.

In non-war times, in association with the lectures, there are displayed in the dissecting-room micro-photographs of tissues and of various stages of development, together with explanatory charts, and skiagraphs of various bones are put up in the dissecting-room window, and are left there for a long period of time.

The work runs through two years, and we see nothing of the men after that, with the exception of those who come to act as assistant-demonstrators. When they leave us they seem to forget all their anatomy. I do not know if it is touched upon in the clinical work; at all events it cannot be touched upon in any way that focusses their attention, because towards the end of the fifth year, when they come to us again, they know practically nothing of what they were taught before. This is the experience of many other schools also.

What I would like to see is some more dissecting. A man must take the body to pieces more than once if he is to have a satisfactory knowledge of it. I would like to see anatomy carried on through all the remaining terms of the course; there should be a constant possibility for every student to obtain instruction in anatomy associated with the work he is doing at any given time in the medical or surgical departments. There should be constant classes of applied medical and surgical anatomy to revise certain essentials. This could easily be arranged if we had a proper staff and a little extra time. I would also like to see in the department a further expansion of X-ray work. Not only should skiagrams be put up so that a man can see the difference between the portions of the body in an X-ray photograph and the appearances as he dissects them, but he should also have his attention drawn to the points which are of an importance which it is difficult at times for him to estimate properly. For more than eight years there has been, in the fifth year, an invaluable, but nevertheless a purely clinical, class of applied anatomy conducted by Mr. Stiles. It has, unfortunately, had to be stopped this year, but it would, of course, be expanded under the system I am suggesting.

DISCUSSION.

Dr. Logan Turner.—I conduct my practical classes wholly by question and answer, and have been struck with the inability of the student to answer simple anatomical questions. The specialist cannot expect the anatomist to teach all the minutiæ of the anatomy of his particular subject and their application to the function or to the pathology of the region, but there are certain broad anatomical questions, *e.g.* the difference in the course of the two recurrent laryngeal nerves, or the arrangement of the lymphatics in the neck, that one would expect to be answered by most students; but they are not.

I came across a letter the other day which my father had written to Sir John Struthers of Aberdeen nearly forty years ago, when the question of anatomy and the examinations in anatomy was under discussion.

> General Medical Council,
> London, 12*th July* 1880.
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> My dear Sir,—Since I came to London I have been making inquiries into the practice, both in London and Cambridge, pursued by the medical authorities as regards the periods of the anatomical examinations. At the College of Surgeons of England, although the examination in anatomy takes place at the end of the second year of study, yet the final examination comprises an examination, both written and oral, in topographical anatomy. In Cambridge, although the candidates for the *degree of M.B.* are admitted to the examination in anatomy and physiology at the end of the second year of study, all candidates for the *Surgical degree* have to go through a subsequent examination, both written and oral, in surgical anatomy, and the Professor of Anatomy is one of the examiners. At the University of London, questions in surgical and medical anatomy form a part of the final examination for the degree of both Bachelor of Medicine and Bachelor of Surgery, whilst for the final examination for the degree of Master of Surgery, candidates are required not only to answer questions on surgical anatomy, but to dissect a surgical region.
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> It is clear, therefore, that these bodies do not, as some of your colleagues have argued, give up the testing of a man's qualifications in anatomy before he begins his third winter of study, but make an examination in anatomy, when the qualification to be conferred is a surgical qualification, a part even of the final examination. Our colleagues, who have taken up a position antagonistic to anatomy, appear to have forgotten that a Scottish University degree examination is for a degree in surgery as well as for a degree in medicine, and that if we were to cease to examine and educate in anatomy before the beginning of the third winter, we should lower our educational standard, not only below that of the Universities of London and Cambridge, but even the English College of Surgeons.
>
> If you should be driven to make an appeal to the Privy Council, which I trust may not be required, the practice of London and Cambridge as regards their surgical qualifications should be referred to.
>
> Wm. Turner.

It seems to me that there we have a means to an end: could not a further examination in anatomy be held in connection with our final examinations?

Mr. Dowden said that it would be a great help to the student if he began the study of surgery as early as that of anatomy. As a demonstrator in the

anatomy rooms he had always found that he could interest the student by associating the dissection with some practical surgical point. He was of opinion that the junior surgeons and specialists should act for a time as demonstrators of anatomy. Their clinical outlook would give the subject a living interest to the student.

Mr. Miles, referring to the need for co-ordination in teaching, suggested that not only should the anatomist take a share in the teaching of the clinical subjects, but that the clinicians might go back from time to time and aid the anatomist, by directing the attention of the students to the anatomical points which have a direct and important bearing on their clinical work. So far as surgery is concerned, this object is partly achieved by maintaining the old Edinburgh tradition that all the younger surgeons spend a probationary period as demonstrators of anatomy. He dissented from the view that had been expressed that anatomy should not be merely ancillary to the more clinical subjects. If anatomy is not to be the hand-maiden of surgery, he did not know what it is to be. In teaching students, the primary object of the anatomist should be to make anatomy ancillary to the clinical subjects.

Mr. Wood said that as a demonstrator of anatomy he had been very much struck by the great interest the student takes in any surgical point to which his attention is drawn in an anatomical demonstration, and emphasised the value of impressing the facts of surgical importance on the student during these demonstrations.

Dr. Chalmers Watson said the interest of the student would be enormously increased by bringing into greater relief from the very outset the vital aspect of his anatomy as it can be revealed by X-ray work, *e.g.* in relation to the thoracic and abdominal organs and the joints.

Dr. F. D. Boyd said that it was most desirable that some means should be found of so co-ordinating the teaching that the student should retain his knowledge of anatomy after leaving the dissecting-room. Speaking as a teacher of medicine, he found that when the students first came to the wards, just after passing their anatomy examination, their knowledge was fair, but by the time they came to the final examination it seemed to have been lost. He did not refer to such matters as the finer anatomy of the central nervous system, for which, if he meets with a difficult case, the practitioner can fall back on the text-books, but to ordinary gross anatomy. In practice it is necessary to know the normal anatomy, and how by the physical signs the subject is not normal. He did not know where the fault lay, but the teachers of medicine had to face the fact that the student appears not to have paid sufficient attention to recall what he had been taught by the anatomist.

Mr. Wilkie asked for further details as to how the co-ordination between teachers of anatomy and the clinical subjects is to be carried out.

Dr. Rainy.—There is no doubt that when students appear at the final examination they have forgotten much of their medical anatomy. That this is not the fault of their anatomical teachers is shown by the fact that the same students, when they commence clinical medicine in their third winter, have quite a fair knowledge of regional anatomy. Unfortunately, they fail to carry on this knowledge through the subsequent years of the curriculum. In part

the blame for this rests with their clinical teachers, who, amidst the multitude of facts which they have to impart, are apt to assume that their students will themselves keep up their anatomical knowledge. This, in the case of the majority of students, is a mistake; and unless the facts of anatomy are constantly recalled during the ward teaching, the bulk of the class will neglect to refresh their memories on a subject which is essential to a right understanding of disease. The clinical teacher should therefore utilise drawings and anatomical casts of the viscera *in situ*, as well as demand verbal answers from the students in tutorial classes and also in ward cliniques.

Other clinical aids to the appreciation of medical anatomy, such as X-ray photographs, have their place also, but the place is a subordinate one. Skiagrams represent not direct facts in anatomy, but shadows of these facts; and, like all shadows, are capable of almost infinite distortion. It is only after the student knows his normal anatomy that the use of radiographs is likely to be of any value; as a substitute for direct anatomical observation they will only lead to erroneous conclusions.

Probably the only way in which we are likely to maintain and broaden the anatomical knowledge which is fundamental for the appreciation of "internal medicine" is by a fuller co-ordination between anatomy and the later subjects of the curriculum; and this can best be achieved by the teachers of anatomy conducting during the later years of the curriculum special courses on medical anatomy, by the clinical teachers building their instruction more definitely on an anatomical basis, and by the more systematic introduction in the final clinical examinations in medicine of questions on such points in the anatomy of the viscera and nerves as are basal for a proper understanding of disease.

Dr. Traquair referred to the difficulty of obtaining sufficient anatomical material to admit of the student making a thorough study of certain parts, particularly the organs of special sense.

Professor Lorrain Smith.—The club is agreed that we must do our utmost to bring the teaching of anatomy into relation with the problems which the student has to face in his hospital work in general medicine, in general surgery, and in the special subjects. There is another question which we have rather neglected—the teaching of minute anatomy—which is a vitally important question in connection with the development of the teaching of anatomy. We in the pathological department feel the lack of the students' knowledge of the normal anatomical minute structure of the body, and we often wish that their information could be more real and more extensive, and that they should have a familiarity with the appearances and variations of structure which appear normally in the human body before they come to pathology; for example, one has often to begin teaching them what lymphoid tissue is. They never realise that this is of any importance in the structure of the body. Professor Elliot Smith's suggestion is that the teaching of anatomy should be so conducted that it is throughout both macroscopic and microscopic. Speaking from the point of view of pathology, we would hope, should this be carried out, that the student would come to us much more interested in the histological and structural aspect of the problem of the study of disease. No doubt it is a question of time, but it would be profitable to sacrifice something in order to get it fully realised.

This leads me to a point as to whether these sciences are to be taught as ancillary to the practical sciences of the profession. We have to get into the minds of the students the idea which lies at the bottom of these sciences, and in order to do that we must try to interest them in the science for its own sake to begin with. They carry the interest of the anatomical idea, the physiological idea, the therapeutic idea, on into their practical work. It is most important that they should get into their heads thoroughly the anatomical idea, to show them the exceeding interest of the development of structure, the tenacity with which the organism holds to its structure, the way in which it tries to recover its structure when it is destroyed by pathological conditions, etc. ; similarly with the physiological idea—how far the various functions of the organ can be varied under physiological conditions to begin with, and latterly how the organism in acute or chronic disease struggles to reassert the physiological activities of the organs in process of recovery. I think we have to keep in mind that we are teaching the student to think physiologically, anatomically, and zoologically at the same time as we are equipping him for the utilitarian purposes of the medical profession. I do not think we should rely too much on trying to engage his interest *because* it will be useful to him some years afterwards. We must engage his interest because the subject in itself is of exceeding interest to anybody who takes the trouble to study it. Call it morphology, or physiology, or what you please, the scientific interest of the study of these things is, if you get the mind of the student arrested, overwhelming. I think if this is so, he will become later a more scientific doctor or surgeon. If you take sufficient trouble with your students, it is perfectly marvellous the way in which their minds awake to the interest of the question. I have a group of students just now studying pernicious anæmia, and the interest with which they are carrying it out is wonderful. These men, when they come to deal with patients suffering from anæmia, will feel the benefit all their lives of having been thoroughly inspired with the desire to investigate this point as far as they possibly can, and get all the light which pathology and medicine have been able to throw on the subject. They also take up tuberculosis and the spread of tubercular disease. The fact that they have gone into the pathology of it as minutely as they can, will turn out to be of enormous benefit to them when they come to deal with the subject practically in their clinical years or in their graduate life. Thus I hardly agree with Mr. Miles.

Mr. Miles.—I think you have proved my point to the hilt.

Dr. Byrom Bramwell.—Does Professor Robinson think the teaching of anatomy as applied to surgery would be better done by the anatomists or the surgeons? It always seems to me that the surgeons and the specialists and the physicians, who must make a profound study of the anatomy of their special department, are far more fit to teach the senior student than the anatomist, who has not the direct knowledge to bring to bear on the special points of interest.

Dr. Sillar.—One of the great defects of the study of anatomy is that you are dealing with the machine apart from all movement, and the lifeless tissue does not tend to stimulate enthusiasm for it. Might some sort of demonstrations taken very early on the living body not obviate that lack of interest by

showing the relation of the structure to the activities of the body. Would not the interest of the students be stimulated by seeing certain of these movements actually in the dissecting-room—for example, the circulation of the blood. The study of anatomy has been divorced from the study of physiology very largely, because they happen to be situated in different departments: might it not be useful in the first stages of his anatomical studies to show the student the circulation of the blood in, say, the web of the frog under the microscope; and to carry that a little further in the living subject, under anæsthetics, to show the movements of the muscles—things, for example, that the physiologist does not necessarily deal with, because these movements are what one might call the coarser movements of the body. The physiologist deals with the niceties of the body and the finer physiological processes, but the actual anatomical movements of the muscles demonstrated might have an extraordinarily stimulating effect upon the students' minds.

The anatomists have all taken for granted that the dissection of the human body is the best means of learning anatomy. Is that really true? I learned far less from my own dissections than from the beautifully dissected preparations in the dissecting-room. I would like to know whether the anatomist really thinks it essential that the student should dissect the whole body—whether it would not suffice to dissect thoroughly one part of the body, and then study the rest of the anatomy on dissected preparations.

I know that I learned a very great deal of anatomy largely by rote, and that in itself destroyed an enormous amount of interest. I never could remember which vagus nerve supplied the front and which the back of the stomach. When you get to that condition of guesswork the subject becomes uninteresting. It was not until the embryologist pointed out that the stomach, being originally an antero-posterior organ, the one came round on the one side, and as the stomach turned round the left vagus will still remain in its position. The little embryological fact stuck in one's mind.

Dr. J. S. Fraser urged the importance of the student studying more closely by dissection the anatomy of the organs of special sense.

Professor Waterston said in reply.—We have had, very much as I expected, the subject looked at through different spectacles. The surgeon wants anatomy taught surgically, the radiographer from the standpoint of X-rays, and the ear, nose, and throat specialist would like more attention paid to these organs. The anatomist has to decide what to teach, with the means at his disposal. I quite admit we may sometimes be in fault in teaching unimportant minutiæ. But who is to settle this? When you look at it from the standpoint of different specialists there is hardly a single anatomical fact in the whole of the body that is not significant. I have been struck with the extreme importance of almost every minute anatomical detail one can think of. For this reason a phrase which always annoys me is "points of special interest." My own experience agrees with that of the chairman, that it is not necessary to go out of one's way to excite the interest of the students in the point at issue. Students, when they have the thing put before them, have a real and deep interest in the question, and extraneous aids are quite unneeded. As an instance of this I may refer to some of my students who are investigating different problems quite without any suggestion on my part. They asked me if they might prosecute some original work. One group

wished to work on the cerebral convolutions, and another is studying the development of the vermiform appendix.

From one standpoint, anatomy is undoubtedly an ancillary subject; yet surgery is largely an outcome of anatomy. I prefer to say that one of the roots of surgery is growing in the field of anatomy. To teach anatomy purely from the applied standpoint spells nothing but deadness in anatomical instruction.

When Dr. Chalmers Watson suggests such improvements as he has done, he must surely be quite ignorant of the equipment of modern anatomical departments, which are now well supplied with X-ray photographs.

I agree with Professor Lorrain Smith as to the association of histology with coarse anatomy. As a matter of convention the teaching of histology is not left to anatomists. Probably it would be better if it were, although it would necessitate additional staff and equipment. One does, however, teach the elements of histology by means of micro-projection. Dr. Sillar's remarks about embryology in relation to anatomy were most instructive, and I can give him many other instances showing that embryology is an essential part of human anatomy.

Professor Robinson said in reply.—I am in agreement with much that Professor Elliot Smith's paper contains, and I am at one with Professor Waterston and Professor Elliot Smith in thinking that histology should be taught in the anatomy department. You ask, quite rightly, that anatomy should not be taught simply as a technical subject, but, in that case, if we ever teach histology, you should not ask us to teach human histology only, without reference to its general scientific bearing. Personally, if I were teaching it I should wish to deal with it chiefly from the medical point of view, but to throw any insight into it, it would be necessary to refer to outside points at the same time. It might be possible to make human histology the basis, and tack the rest on to it; whereas at present comparative histology is the basis, with human histology tacked on to it. I am glad to find that Professor Elliot Smith is of the opinion that anatomy should be carried on into the later stages of the course.

With regard to the question of the junior surgeons teaching in the anatomy department, my experience in London was that you could not get the junior surgeons, because they feared they might infect their patients, and it was stated that in the hospitals where it was allowed the results were not so good as in the others. We have not yet suffered in that way in Edinburgh. With regard to our "subjects," they are perhaps less likely to infect anything or anybody than anything else in the town, and I think the applied anatomy ought to be taught largely by the junior surgeon and junior physician; they are the people I had in my mind when I was proposing that the subject of applied anatomy should be carried on further in the curriculum. You cannot expect the junior surgeons and junior physicians to give up much time to the anatomy department, however, unless sufficient remuneration is provided. If they give time, it must be a definitely settled period, and not just when it suits them. If the university is prepared to meet the requisite expense, we shall have no difficulty in getting the assistance we require. This opinion probably meets the point of Dr. Bramwell's question as to whether applied anatomy should be taught by the surgeon rather than by the anatomist. I am glad to know that Dr. Boyd and Dr. Rainy agree that the students do

know something of surface anatomy when they leave the anatomy department. I cannot say why they do not know it later; but as I had the men in the anatomy department in London both when they were preparing for the second M.B. and for the Final Surgery and Medicine examinations, I can give you my experience there. I had men in London who took the highest places in anatomy, and yet later on, when they were preparing for their finals, they knew practically nothing of anatomy. *We* did not kill their knowledge when they were with us, but it had been killed somehow between the time of leaving us and the time of coming back to us. They soon picked it up again.

We have, incidentally, been accused of not teaching things that are important. Dr. Turner referred to the recurrent nerves. We deal with them, not once nor twice, but many times. The same is true with the nose, which Dr. Fraser states is not properly known by the students. When I want to get together the remains of my "parts" at the end of the term for preparations, my difficulty is to get "parts" which have not been cut to pieces. This shows that the men do go more or less over the nose, and at the time they know something about it. Why do they forget later? Simply because they hear nothing of anatomy, after leaving us, for a long time. They hear about so many other things that anatomy gets crowded out of their heads. With revision they pick it up again, but without continuation you will not have the memory of what they have learned remaining constantly in their minds.

What are we to teach generally, and how far is it to be scientific and how far purely technical? It depends whether you are talking of a small school where you have each individual under your finger, and can interest him or her—sometimes to their detriment—in the things in which you are interested, and incite them to specialise. I think that is to be avoided. In the time at disposal it is necessary to give a general idea of anatomy, as scientific as you can make it, for by far the majority of students in a large school the whole interest lies in, "How am I going to apply it? What is its value to me as a practitioner of medicine?" On the whole, I should be inclined to say, "In the early years do as much as you can in the science and throw in a little practical interest." But I am convinced that you will get more of interest both for the science and for the practical application the more the student combines his interest in anatomy with something he is dealing with at the hospital at the time.

Dr. J. V. Paterson.—If you *examine* on the minutiæ of anatomy, the students will get up anything to get medals and to pass examinations well, and will learn much that can never be of any use to anybody from a clinical point of view.

Professor Robinson.—What *is* of no interest to anybody? What part of the body is there that will not at some time become important? The specialists want more time spent on the organs of special sense and the head and neck, and have not much respect for the thorax, but what will the physicians say to that? So it goes on all round. All that we can possibly do during the time we have—and that ought to be during the whole five years—is to give a good general scientific view, and to draw attention to the practical applications of the subject to surgery and medicine.

Dr. Sillar looks upon anatomy as a dead subject, and says you do not get to know a thing by taking it to pieces. Is there any machine that you get to

know without taking it to pieces? The deadness of the "subject" is the very difficulty we have with the students; they tend to look upon anatomy as something to be learned from the dead, and the attempt to look upon it as a living subject is a trouble. If the dissector fails to try to find out what everything he dissects does, he is not taking advantage of his training, as we attempt to give it, at the very outset.

I agree with Professor Waterston that we must, to a certain extent, limit the supply of skiagrams. But even if we had a plentiful supply of skiagrams and other photographs of important parts, taken under standardised conditions, so that their true value could be estimated, they would have to be used with care, for they, like prepared dissections, have the great disadvantage that the student loses in them a proper appreciation of depths.

RECENT ADVANCES IN MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

EDWIN MATTHEW, M.D., AND JOHN EASON, M.D.

Splenic Anæmia.

In a Carpenter Lecture, William J. Mayo (*Med. Record*, 27th October 1917) discusses the relation of the spleen to certain obscure clinical phenomena. He points out that pathology and experimental medicine have contributed very little to our knowledge of the organ, and that what we know and what we think we know about the spleen is largely the result of circumstantial evidence, having its origin in comparative anatomy and physiology, and the results of clinical experiences capable of different interpretations.

The spleen is derived from mesoblastic tissue and is probably concerned largely with filtration of certain substances from the blood, and the product of its activities is delivered to the liver through the splenic vein.

The organ has a very scanty nerve supply from the sympathetic system, but it does contain a very considerable amount of non-striated muscle fibre. Keith has demonstrated that the non-striated muscle has the power of originating contractions independent of nerve supply, and exhibits a most primitive form of control. The spleen has what might be called a beat, which consists of an enlargement following food intake, with a gradual resumption of its normal size after several hours, showing a definite connection with the digestive function. This is further indicated by the fact that its blood-supply is from the cœliac axis—the same source as that of the derivatives of the foregut, the stomach, the liver, and the pancreas. The blood entering the spleen comes into direct contact with the splenic pulp, the smaller blood-

vessels having lost their elastic coats. This renders the organ friable and vulnerable to trauma, and also extraordinarily susceptible to the influence of radium.

The enormous blood-supply of the spleen clearly proves it is not a retrogressing organ. It may be surmised the spleen does not possess an internal secretion of importance from its extremely limited sympathetic nerve supply and from the slight metabolic disturbance caused by the removal of the organ. On hypothetical grounds it seems probable that the spleen develops certain enzymes which are important to its function, but it is equally evident that the function of the spleen is shared by other lymphoid and adenoid structures, and that on the removal of the organ the function is continued by these collaborating structures.

In discussing the relations of the spleen to the blood he states that Robertson and Rous (*Journ. Exp. Med.*, 1917, xxv. 651, 664) have come to the conclusion that fragmented erythrocytes are not only removed there but that fragmentation must take place in the spleen.

In some of the anæmias, notably hæmolytic icterus, the enlargement of the spleen may be a work hypertrophy—as suggested by Chauffard and Widal—the fragility of the corpuscles in this condition leading to undue fragmentation and destruction in the spleen.

Relation of the Spleen to the Liver.—Cirrhosis of the liver secondary to splenic disease, if portal, is of the atrophic or hob-nail type, showing that the cause concerns protein, not fat, metabolism. In biliary cirrhosis, on the contrary, the liver is always enlarged. This form is even less well understood than the portal type, and there are various subdivisions, such as the pigmentary (hæmochromatosis) and the so-called Hanot's cirrhosis; the latter designation evidently includes cases of hæmolytic icterus (acholuric jaundice), and serves only still further to confuse the issue.

The enlargement of the spleen which so often accompanies portal cirrhosis suggests that the primary source of these poisons may be in the spleen, and in some cases of portal cirrhosis in which Mayo and his co-workers have removed the enlarged spleen the results, he says, justify the presumption. In Banti's syndrome the portal cirrhosis is a late stage of splenic anæmia, and even in advanced disease the removal of the spleen often cures, the liver regenerating to a marked degree. In portal cirrhosis supposed to be primary the spleen may be enlarged to a considerable extent without being manifest until a late stage. Sometimes it is a moot question whether the liver or the spleen was first affected. All this goes to show how little is definitely known about the subject.

The biliary cirrhoses, in many cases at least, have their origin in infections in the common duct, associated with gall-stone disease. In such cases the spleen may or may not show great enlargement. In

other cases in which no such infection exists in the common duct the spleen may be found to be very large, and suggests the possibility that it has carried to the liver toxic materials which have safely passed through the portal side but have exercised a large influence on the hepatic cells and the smaller bile ducts. This, Mayo says, we know to be the fact in connection with hæmolytic icterus, as the removal of the spleen promptly relieves the jaundice. The enlarged liver thus may not be a true biliary cirrhosis but in part at least an excess of function, causing hepatic hypertrophy as well as a cirrhosis in the attempt to care for the erythrocytic débris destroyed in the spleen and carried to the liver by the portal vein.

Relation of the Spleen to Bacteria and Protozoa.—Mayo states that spirochætal "hibernation" in the spleen is not unusual. Failure to eradicate the disease by salvarsan and prolonged mercurial treatment may result in a syphilitic spleen, which permits not only luetic reinfection of the body but also causes a high grade of chronic anæmia. In four cases of this type, removal of the spleen promptly cured the anæmia, and the lues thereafter quickly responded to renewed treatment. In all of these spleens either spirochætes were found or gummata in spleen or liver were demonstrated, showing again the relation of the spleen to hepatic disease.

Hæmolytic Icterus.—The Mayos have performed splenectomy nineteen times for hæmolytic icterus and the results have been astonishingly good. William J. Mayo says he does not know of an operation giving more gratifying results. The jaundice which the patient has had for perhaps years will be perceptibly less in forty-eight hours, and within four days will have quite disappeared. Sixty per cent. of his patients had complicating gall-stones, apparently due to the greatly thickened bile, the result of pigments derived from the disintegrated erythrocytes. Splenectomy, as a rule, is not difficult in these cases, for although the spleen may be quite large it is seldom adherent to a marked degree. There was one operation death in the series of nineteen cases. This patient was operated on during a crisis, and death probably would not have occurred had the operation been performed in the interval between crises.

Splenic Anæmia and Banti's Disease.—The gastric hæmorrhage of splenic anæmia is a symptom well worthy of attention. It is not different from that which occurs in connection with hepatic cirrhosis, and it is altogether probable that many of the unexplained hæmorrhages from the stomach, in which no local lesion of the gastric mucosa is to be found, are a result of the toxic condition which precedes, accompanies, or is caused by splenic anæmia and cirrhosis of the liver. In gastric hæmorrhage we must think of the spleen and the liver as causative factors, just as in the differentiation of the causes of jaundice the spleen must be thought of as well as the liver. The Mayos have removed

the spleen in forty-three cases of splenic anæmia with four deaths. The operation is more difficult and dangerous than in any of the other diseases for which splenectomy is indicated.

As E. Moschcowitz (*Journ. Amer. Med. Assoc.*, vol. lxix. No. 13) points out, the literature on Banti's disease affords a most disjointed impression and leaves little material on which to base an estimate of the validity of Banti's disease as a nosological entity. Practically the only criticism of Banti's views has come from pathologists, and, significantly enough, the general tone of it is one of guarded scepticism. According to Moschcowitz, nobody, not even Banti himself, knows definitely what Banti's disease connotes.

In analysing the clinical and pathologic features of the disease called by his name, we find that Banti has hedged his malady about by so many criteria that it is almost unreasonable to expect any single case to conform to every requirement. These requirements are clinical and pathologic, and may be classified as follows:—(1) The disease must be without known etiology. As soon as a definite cause for the malady is established, the case is no longer regarded as a possible "Banti," but is at once thrown out of court. (2) The blood picture must be typical. (3) There must be three stages, two of which are fairly well defined clinically. (4) The signs of anæmia and splenomegaly must precede the cirrhosis.

Pathologically the data which make a diagnosis of Banti's disease possible are the following:—(1) A splenomegaly of considerable size; (2) a cirrhosis in the liver of the Laennec type; (3) a histologic fibrosis of the spleen arising without the interposition of fibroblasts; (4) a progressive eccentric fibrosis of the Malpighian follicles; and (5) a usual but not constant endophlebitis of the splenic vein.

Banti admits there is nothing pathognomonic in the pathological findings, but no matter how clear the clinical diagnosis of Banti's disease may be, unless the pathological findings are those premised by Banti, the disease is not Banti's disease. Moschcowitz admits that the clinical picture described by Banti is sometimes seen, and that at necropsy the lesions described by Banti are found, but the literature teems with variations from this general type, showing that Banti's disease has most indeterminate outlines. Clinically this is so, and it seems well agreed by everybody, even by Banti himself, that a diagnosis is impossible on the basis of the pathological findings alone.

Moschcowitz's conception of Banti's disease is based on an analysis of published work. He is led to conclude that—(1) All the evidence thus far submitted gives us no right to believe that splenic anæmia and Banti's disease are not identical. (2) There is no reason for differentiating Banti's disease from other splenomegalies associated with anæmia on the ground that in Banti's disease no etiology can be determined. A nosologic distinction based on whether a disease has

a known or unknown etiology has no *raison d'être* in clinical medicine. Rather, he believes, we should regard Banti's disease as merely a nosologic and clinical entity, which may be due to both known and unknown causes. The known causes are syphilis, alcohol, malaria, trypanosomiasis, persistence of umbilical vein, etc. In all these maladies a splenomegaly, an indurative splenitis, with eventual atrophy of the Malpighian follicles, and an anæmia are the predominant features. It may be argued that in the splenomegalies associated with alcohol, malaria, syphilis, etc., the causes of the disease and some of the clinical phenomena differ from those which Banti described. In reply, Moschcowitz answers—(1) Banti's disease has no typical course and diagnostic symptoms; indeed, if the specifications which Banti predicated are strictly adhered to as criteria for making a diagnosis, we would find that Banti's disease is extraordinarily rare. (2) A clinical diagnosis of Banti's disease has been made by most able clinicians in cases that eventually proved to be cirrhosis of the liver, malaria, syphilitic splenomegaly, etc. Moschcowitz cites many instances of this in his communication. Again, it may be argued that the pathology of Banti's disease is quite different from that of the splenomegalies of known origin. But the pathology of Banti's disease is by no means a specific one. The fact that many observers hold that Banti's disease and cirrhosis of the liver are identical shows that this contention is not unjustified. (3) Banti's explanation of the cirrhosis of the liver as secondary to a splenotoxin is wrong. Further, he does not believe that patients who show at necropsy no cirrhosis of the liver should be regarded as affected with a different malady or that such cases should be regarded as instances of Banti's disease in the first stage. It is more logical and would simplify matters considerably to regard these variations as phenomena of one and the same disease; that a fibrogenetic toxin, probably of intestinal origin, attacks the organs draining the portal area, causing primarily a fibrosis of the spleen, and, if the toxin is sufficiently intense or the patient lives a sufficiently long time, causing a cirrhosis of the liver as well. The common association of sclerotic vascular changes in the mesenteric vessels in Banti's disease are most readily explainable on the same grounds.

Finally, in view of the fact that Banti has failed to make out a case for the disease called by his name and has not shown it to be a distinct entity, the term "Banti complex" should be substituted for the term "Banti's disease." J. E.

DERMATOLOGY.

UNDER THE CHARGE OF

R. CRANSTON LOW, M.B., AND F. GARDINER, M.D.

Self-Inflicted Skin Eruptions in Soldiers.

Raffaele (*Giornale Ital. delle malat. vener. e della pelle*, 1916, p. 415) reports one hundred cases of self-inflicted eruptions in soldiers in the Italian Army during one year. They occurred especially in soldiers who were under orders to go to the front, but also amongst those in the trenches, and often just after they returned from leave. Forty-three per cent. were self-inflicted wounds or cuts, 20 per cent. eczematous eruptions, 20 per cent. infected dermatites, 9 per cent. bullous dermatites, and 8 per cent. hard traumatic œdema. In many cases the soldiers attributed the condition to injuries from falling stones, the result of explosions, etc. The lesions occurred on any part of the face, body, or limbs which was easily accessible to the hands. In the same regiment several men showed the same type of lesion, evidently by one man suggesting it to another. Various forms of irritants were used, such as strong antiseptics, and juices of irritating plants to produce oozing eczematous eruptions. Bullous lesions were produced by the application of boiling water. As a rule the diagnosis of such cases is easy, provided that one is on the outlook for them. They usually show a more abrupt margin than natural lesions and are always in situations within easy reach of the hands. The mere fact that the patient denies having put anything on the skin should carry no weight in the diagnosis. All medical men treating soldiers should be on the lookout for such cases, as they are probably much more common than is generally supposed.

Skin Diseases and Their Treatment Under War Conditions.

MacCormack (*Brit. Journ. Dermat.*, 1917, p. 141) gives some very useful hints about various common skin diseases occurring in the Army. Scabies is one of the most important of these. MacCormack lays special emphasis on the important features of difference between scabies as seen in civil practice and in soldiers at the front. The hands were often completely free from lesions and the characteristic interdigital burrows were only present in about 13 per cent. of the cases. The whole patient should be inspected, and, above all, the penis. Interdigital vesicles rather than burrows should be looked for. Impetigo of the buttocks is pathognomonic of scabies, and every case of boils should be looked upon with suspicion. Treatment to be effectual must be thorough. The ordinary three days' application of ung. sulph., with a thorough scrubbing at the commencement so as to open up all burrows

and vesicles, is still the best method of treatment. As the acarus is very difficult to find, this test is useless in trying to determine whether a case is cured. It should also be remembered that after the sulphur treatment has been employed, many lesions persist and the itching continues for some time after the disease is cured. The impetigo associated with scabies is usually on the buttocks and elbows chiefly. It is frequently accompanied also by a deeper streptococcal lesion, viz. ecthyma. The latter lesions are usually on the lower limbs and show pustules like small boils, but they never develop any central core like a boil. The lesions heal often with scarring and pigmentation. Not infrequently, and especially on the buttocks, the disease is followed by papillomatous or warty growths which in their appearance and chronicity resemble warty tuberculosis. MacCormack finds that painting with 3 per cent. silver nitrate in sp. æth. nitrosi is very efficacious in these lesions. He obtained little or no benefit from vaccines. Another not uncommon type of impetigo is the linear variety. This affects the legs chiefly. MacCormack is inclined to consider these cases as a combination of traumatism and secondary infection, but it is sometimes extraordinarily difficult to prove that the patient has produced the lesions intentionally.

Seborrhœa is also an important disease in the Army. It affects the scalp, eyebrows, beard, moustache, and flexures of the limbs. The liability to relapse is very great, and many of these cases are only fit for some special form of employment. Secondary impetigo on the top of seborrhœa is also extraordinarily common. Treatment in the latter cases should be directed against the seborrhœa rather than the impetigo.

Psoriasis in a soldier should be treated even although it might not be bad enough to prevent him carrying on his duties. As long as it is present he has a ready excuse for "going sick," and his comrades object to him, as they think the condition is syphilis.

Semon and Barber (*Brit. Journ. Dermat.*, 1917, p. 173) also report experiences very similar to those recorded by MacCormack. They point out that in pediculosis corporis the insect, in the majority of cases, lays its eggs on the hairs of the pubis and perineum and sometimes of the axilla, and unless these are removed, sterilisation of the clothes cannot be efficient. The authors also draw attention to the fact of the frequency of seborrhœic infections on the top of scabies. In cases where seborrhœa of the scalp is marked, or where the patient has had one or more previous attacks of seborrhœic dermatitis, the scabies causes a return of the condition.

The Habitat of the Pediculus Corporis and the Rapid Diagnosis of Pediculosis.

Owing to the great prevalence of pediculosis in the armies taking part in the present war the accurate diagnosis and treatment of that

condition has come to be an important one. Bulliard (*Annales de Dermat.*, 1917, p. 501) draws attention to some facts hitherto not sufficiently widely known. The fact that the pediculus corporis is also known as the pedic. vestimentorum has led to an erroneous impression that that pediculus lives and breeds on the clothes and only attacks the body to feed. The clothes are usually examined for evidences of pediculi, but it should not be forgotten that much valuable information can be got by examining the hair of the body, and especially of the pubic region. There the nits will usually be readily found. They are fixed on to the hairs by means of a regular triangular mass of cement. It is only irregular and lateral in relation to the nit when the local conditions of insertion are defective. In the absence of visible lice, counting the number of cells which compose the lid of the nit will be found useful in making a differential diagnosis between the different kinds of pediculosis. In pediculosis capitis they vary from 10 to 13 in number, the average being 11. In pediculosis corporis they vary from 12 to 18, with an average of 15.

From a practical point of view, in all cases of pediculosis a careful inspection should be made of the hairs on the body, and especially of the pubic region. Thorough soaping and the application of antiseptic ointments such as camphorated oil may be sufficient, but shaving the parts obviates any possibility of a recurrence. In addition, the sterilisation of the clothes must not be forgotten.

A Dermo-Epidermitis Supervening around Old Wounds and Fistulous Openings.

Inflammation of the skin around old wounds and fistulous openings is frequent. Desaux (*Annales de Dermat.*, 1917, p. 393) has examined twenty-two such cases. The wounds occurred on the face, scalp, and thorax, but were most frequent on the limbs, and more often occurred on the lower than the upper limbs. The wound around which such a condition develops may affect only the soft parts, skin and muscles, but much more frequently it is accompanied by a fracture. It is always an infected wound, and in the majority of cases the dermatitis makes its appearance when the diameter of the wound has diminished and there is only a fistula left leading down to an infected bone. There is a yellowish purulent discharge, and the opening is surrounded by a ring of cicatricial tissue over which the skin is bluish, thin, and often adherent to the subjacent tissues. More rarely there is no fistula, but the wound continues to suppurate, and, exceptionally, the wound heals completely but the skin later becomes inflamed. The dermatitis usually begins two or three months after the wound is received. The wound usually becomes itchy some days before any change is visible in the skin. Then the epidermis of the cicatrix swells and comes off on

the dressings, and as the itching is severe the patient often damages the skin considerably by scratching. The inflamed area of skin oozes serous fluid and later pus, which may crust on the surface. It spreads by a process of extension at the edges. In some cases the dermatitis begins at a short distance from the wound by the appearance of minute itchy vesicles in the skin ; these rapidly suppurate, and the condition spreads around and over the wound, producing the same result as in the other case. The same condition is also sometimes seen in soldiers who receive a fairly extensive but superficial wound and who do not get it properly dressed. After some days the whole area is infected and crusted. The dermatitis is sometimes excessively itchy, usually ovoid in shape, the long axis running in the long axis of the limb. The edges are sharp, irregular, and festooned. The central part oozes a sero-purulent discharge and if left untreated crusts over. Beyond the crust is a raised collar of inflammation, where there is serum or sero-pus in the skin, and beyond that again a red zone of hyperæmia. The inflammation may remain limited to the skin but may spread deeper and lead to sloughing of the tissues. The adjacent lymphatic glands may be painful and slightly swollen. As the dermatitis heals and the inflammation subsides, the skin becomes dry, scaly, and wrinkled, and after complete healing a brownish pigmentation is sometimes left. When there is a severe injury to the limb, and especially to adjacent nerves, the healing of the dermatitis may be delayed on that account. Such dermatites tend to persist as long as the wound or fistula is not healed, but do not seem to aggravate the wound. The skin may heal in two or three weeks, but it usually takes some months. Certain complications may accompany this dermatitis—the lesion may go deeper and lead to actual ulceration. On the other hand, various lesions may appear on the skin at a distance from the original dermatitis. Especially after much washing or the application of moist dressings an extensive eruption of vesicles filled with sero-pus may suddenly appear all over the affected limb. These lesions seem to be identical with impetigo contagiosa. Also a purulent folliculitis may occur extensively on the limb, which in some cases goes deeper, producing actual furuncles. These cases of folliculitis, associated with the dermatitis, are always difficult to cure. In other cases the dermatitis may develop into a dry scaly eruption resembling psoriasis, and some of these cases, although apparently looking dry and scaly, actually show minute vesicles in the skin. Others go on to a moist dermatitis, indistinguishable from a seborrhœic eczema, and in yet others there is marked induration of the skin, with lichenification.

Microscopically the skin in these cases of dermatitis shows vesicles in the epithelial layers filled with serous fluid and polymorphonuclear leucocytes, and in the more scaly varieties there is overgrowth of the Malpighian layer, with parakeratosis on the surface. The vessels are

dilated and the whole corium œdematous and infiltrated with leucocytes. Bacteriologically this skin affection is associated with the streptococcus and staphylococcus aureus. The active microbic agent which causes the dermatitis is the streptococcus, which is always found at the spreading edge. The staphylococcus seems to be secondary. As the dermatitis becomes older the number of organisms diminishes; the streptococcus rapidly loses its vitality but the staphylococci retain their virulence a longer time. When the lesion is nearly healed, cultures of small diplococci which resemble staphylococci, but give a white porcelain-like culture, appear. These organisms are also found in the later scaly variety of the eruption. Exceptionally, the bac. pyocyaneus has been found to be present. The superficial wounds and fistulæ were found always to show the presence of streptococci. Staphylococci were also found in the superficial part of the fistulæ but not in the deep. From the superficial cicatrised wound the diplococcus giving white porcelain-like cultures was also found. The streptococcus therefore is the cause of the dermatitis and the staphylococcus only a secondary infection. The traumatism of the skin caused by the use of the antiseptics employed to treat the original wound or a general lowering of the resistance of the skin from injury to nerves, etc., seems to be the predisposing cause.

In treating such chronic wounds the use of moist dressings, which keep the skin sodden, should be stopped as soon as possible. Painting with iodine, if repeated, and X-ray applications for diagnostic purposes, often also play a part in their production. R. C. L.

PATHOLOGY.

UNDER THE CHARGE OF

THEODORE SHENNAN, M.D., AND JAMES MILLER, M.D.

Trench Nephritis.

There is still a good deal of difference of opinion as to whether war or trench nephritis is a new condition with a pathology of its own or merely ordinary acute nephritis occurring in the campaigning soldier. Hurst (*Medical Diseases of the War*) states that nephritis does not appear to have been common in any previous campaign except the American Civil War, in which over 14,000 soldiers of the northern armies were invalided for nephritis. According to Rose Bradford (*Journ. R.A.M.C.*, October 1916), the disease was rare in our armies on the Western front until the months of March and April 1915, the April admissions to hospital being not far short of the total admissions for the whole duration of the war up to that time. This high per-

centage of cases of nephritis has persisted. It is interesting that, according to Moret (quoted in *Lancet*, 15th December 1917), the British have suffered most from this disease, the French next, and the Belgians least. Wallis (*Journ. R.A.M.C.*, March 1916) and Moret are not supporters of the view that the disease is due to one specific infection. Rose Bradford, on the other hand, appears to favour such specific infection.

Although nothing certain is known as to the causation of the disease, a number of interesting points have been brought out regarding it. The largest proportion of cases have occurred in men under 35 years of age. Men are affected to a greater extent than officers. Although no branch of the service is immune the cavalry have apparently suffered slightly and the Indian troops almost not at all. Season, locality, and severity of weather conditions have, according to those who have written on the subject, been without influence. Nephritis is not specially common amongst the civilians in the army area. It is not the men in the trenches who are specially affected; men engaged in transport work and men at the base have suffered as much as the fighting men. Bronchitis appears to have a distinct relationship to the disease. Rose Bradford states: "I am inclined to view the cases of acute nephritis described in this paper as due to some infection, the infecting agent causing, in the first place, in many cases some illness, such as bronchitis, severe cold, diarrhœa, etc." Dunn and M'Nee (*Brit. Med. Journ.*, 8th December 1917) are so impressed with the association between nephritis and respiratory conditions that they suggest some connection between gas poisoning and nephritis.

Examination of the urine shows, as a rule, a large amount of albumin. This is the serum albumin and serum globulin usually met with in nephritis. The amount of urine is little, if at all, diminished. Blood is present in some cases but is often not visible on naked-eye examination. The deposit shows blood corpuscles, leucocytes, and casts which may be hyaline, cellular, or granular. Bacteriological examination of the urine gives no constant results. Rose Bradford describes B. coli as being present, especially in hæmorrhagic cases with fever. Dunn and M'Nee found fourteen urines sterile. Twelve contained streptococci; B. coli, staphylococcus aureus, and diphtheroid bacilli were found in other cases. The blood was examined bacteriologically by these observers in forty acute cases of the disease with negative results. Wallis was able to exclude the possibility of mineral poisons, intestinal toxæmia, direct bacterial infection, and septic foci. He also brought forward a certain amount of evidence to show that animals, such as rabbits and monkeys, could be infected with a definite illness, commencing about eight days after the injection of urine from cases of war nephritis filtered through a Berkefeld filter, the suggestion being

that there existed in the urine a virus which is a filter passer. This virus is destroyed at a temperature of 55° C.

Post-mortems have been performed now on a number of cases. Only three fatal cases were observed by Rose Bradford. In one the condition was the termination of a chronic nephritis; in a second case congenitally malformed, atrophied, and hydro-nephritic kidneys were met with; and in the third there was congenital absence of one of the kidneys. Thus no conclusion could be drawn as to the etiology of the disease from these observations. Dunn and M'Nee examined tissues from forty-two cases. Four of the kidneys were the seat of old-standing kidney disease. In three cases no microscopic evidence of damage to the kidney was found. The remaining thirty-five cases showed a fairly uniform lesion. The naked-eye appearances, as is very commonly the case in acute nephritis, were slight. Some of the kidneys were enlarged but most were of normal size. The capsules are non-adherent and the surfaces smooth. The cortex is pale and the medulla congested. With a hand lens a feature can be brought out which is regarded as characteristic, viz. the glomeruli are seen to project from the cut surface as pale translucent globules.

The microscopic appearances are as follows:—Swelling, granularity, fatty change, and catarrh in the tubules. Tubular hæmorrhage is present to some extent in all cases. Long hyaline casts and sometimes calcified débris are found in some tubules. The interstitial tissue shows little beyond some œdema. It is in the glomeruli that the most marked changes are found; they are enlarged, more cellular than normal, and contain little blood. The increase in the cell elements is due to the presence of masses of endothelium-like cells simulating a syncytium. Mitotic division is sometimes seen in the nuclei of these cells. Granules of fat are occasionally seen in their protoplasm. Polymorphs and lymphocytes are present in small numbers, but exudative changes are almost entirely absent and degenerative changes are slight. Occasionally total infarction of some of the glomeruli is seen, the capillaries of the tuft being dilated and engorged with blood. Sometimes hyaline material can be observed blocking the afferent arteriole. Thus the striking feature of the histological appearances is that they are only slightly marked and that cellular reaction and exudation of an inflammatory type are practically absent. The nature of the lesion is, according to the observers, not suggestive of the local effects of bacteria. As regards changes in the organs other than the kidneys, the only ones deserving of special mention are multiple hæmorrhages in the brain observed in two cases and changes in the lungs strongly indicative of the presence of a deleterious agent in the lumina of the air passages—loss of epithelium and covering of the exposed surfaces by layers of dense material resembling fibrin. Both these changes, in lungs and brain,

are found in cases of gas poisoning, and the authors suggest that the pulmonary lesions may have been caused primarily by a noxious agent inhaled from the atmosphere, *i.e.* irritant gas. The authors point to the observation by Henry that when death occurs late—seven to ten days after chlorine poisoning—the renal glomeruli may exhibit extensive inflammatory changes associated with the presence of thrombi in their capillaries. They admit, however, that nephritis is not common clinically after exposure to drift gas. Three such cases have been described by Broadbent (*Brit. Med. Journ.*, 14th August 1915), but they are apparently very rare. J. M.

NEW BOOKS.

A Manual of Nervous Diseases. By IRVING J. SPEAR, M.D. Pp. 660. With 172 Illustrations. Philadelphia and London: W. B. Saunders Co. 1916. Price 10s. 6d.

PROFESSOR SPEAR'S book begins with a short account of the anatomy and physiology of the nervous system, which is well done and suitably illustrated. The account of the diseases which follows consists of an epitome of the main features of the affections of this system and is rather difficult for a beginner to understand and follow intelligently. The reason for this seems to be that too much knowledge is taken for granted, and no attempt is made to single out the salient and cardinal features of the diseases described. Some of the affections are rather scantily treated, and it would be difficult for one to obtain a clinical idea of spastic paralysis, for example, from the description furnished. A useful chapter is that devoted to the examination of nervous cases, and the illustrations render it all the more easy to follow.

Diseases of the Chest and the Principles of Physical Diagnosis. By GEORGE WILLIAM NORRIS, A.B., M.D., and HENRY R. M. LANDIS, A.B., M.D. Pp. 782. With 413 Illustrations. Philadelphia and London: W. B. Saunders Co. 1917. Price $7.00 net.

THE object of the authors of this bulky volume has been to produce a practical treatise on the physical diagnosis of diseases of the lungs and heart, and this object has been attained in a high degree. They have devoted much more space than usual to the acoustics of these organs in health and disease, as it is only through the comprehension of the laws of sound production and transmission that the results of percussion and auscultation can be intelligently interpreted. The book is plentifully supplied with photographs of frozen sections from the cadaver, so

that the anatomical relations of the tissues remain as in life, and these illustrations are most helpful in enabling the reader to comprehend the meaning of the different physical signs and their relation to the underlying pathological conditions.

An interesting and useful chapter is written on the physical findings in infants and young children, in which attention is drawn to the anatomical differences between the infant and the adult chest and to the pitfalls that await the unwary if they interpret the physical signs in infants in terms of what they find in the adult. Extrasystoles are common in the child without any marked pathological condition in the heart, while the pulmonary second sound is both actually and relatively louder than the aortic second. Another practical point insisted on is the necessity for careful and light percussion in the case of children, otherwise "the whole lung as well as the neighbouring abdominal viscera will be thrown into vibration, and topographic percussion will become impossible." Good percussion is or should be a "gentle art."

When we come to the different specific diseases of the chest we have the usual standard text-book descriptions of etiology and differential diagnosis. While these are, in the main, accurate and comprehensive, there are some statements to which exception must be taken. They maintain that it is very rare to find that repeated attacks of acute bronchitis may develop into the chronic form of the disease. This may be the case in America, but in our cold damp climate chronic bronchitis is a very common sequela of one or two acute attacks. No mention is made of influenza as a cause of broncho-pneumonia, but in recent years we may certainly assert with confidence that, apart from children, where the disease commonly occurs as a consequence of measles or whooping-cough, it is the most frequent cause of broncho-pneumonia in adults and old people.

The authors make some shrewd remarks on the use of tuberculin tests for the detection of tuberculous lesions within the body. A positive test does not mean that the individual has clinical tuberculosis. There is a great difference between tuberculosis that can be clinically recognisable and hypersensitiveness to tuberculin. The latter is extremely common in healthy people, and it is a great mistake to assume that because a person reacts to one of the tuberculin tests he is therefore in need of active treatment.

In connection with the X-ray in the diagnosis of pulmonary tuberculosis, it is pointed out that the earliest manifestations of the disease are not visible on the plate, and when a shadow is seen it may be due to some simple chronic infection and is not necessarily tuberculous.

Cardiac pathology and diagnosis are treated in an interesting and exhaustive fashion, though we think that more space might have been given to a description of the conditions which produce the Adams-Stokes syndrome, and of the causes which lead to a cardiac breakdown in

elderly people. The book, which contains nothing regarding treatment, is written with clearness and precision, and may be very profitably read by those who wish to revise and keep up to date their knowledge of pulmonary and heart diseases.

Operative Surgery of the Nose, Throat, and Ear. By HANAU W. LOEB, and Others. Vol. II. Pp. xxiv.+427. With 475 Illustrations. London: Henry Kimpton. 1917. Price £3 net for the Two Vols.

THE first volume of this work was published in 1914. Volume II. begins with a chapter which deals with the operative surgery of the nasal cavities, and is written by Loeb himself, who gives eminently practical hints regarding the technique of nasal operations. We are glad to note that he is strongly against simultaneous operations on the nose and throat of any considerable magnitude. The method employed in dealing with the various operations is as follows:—First we have a short history of the operation, followed by a list of the indications and contra-indications; then the preparation of the patient, followed by the technique of the operation, which, all through the book, is excellently illustrated; and, lastly, the after-treatment, results, and dangers are dealt with. Much space is wasted on obsolete operations on the nasal septum. The new operations on the lachrymal sac by the intra-nasal method and the surgery of the hypophysis are fully described. Major operations on the upper jaw are also dealt with. The section concerned with the operative surgery of the pharynx is written by G. L. Richards. This writer does not go to the extreme lengths advocated by some American surgeons who favour indiscriminate removal of the tonsils in all children of 4 years of age. No less than *ten* operations for the complete removal of the tonsil are described and illustrated. The writer gives some good advice on the serious question of hæmorrhage after tonsillectomy. All through the book is remarkably free from errors, but on page 212, line 12, there is a misprint, the word "anæsthesia" being obviously intended for "anæsthesin."

In Chapter IX. Dr. Robert Levy describes endo-laryngeal operations with the aid of the laryngoscope. This section is rather out of date, as most laryngologists now prefer to employ the suspension method for the removal of simple tumours, or to use the tube spatula with direct illumination. Levy even advocates that in certain cases malignant disease of the larynx should be dealt with by the old indirect method.

Chapter X. is written by Haskin, and is concerned with operations on the external ear and those performed through the external meatus. In it we note some curious statements, *e.g.* (p. 298) that there is danger of wounding "the carotid" in opening a boil on the inferior wall of the

meatus; p. 303, that the most common cause of chronic middle-ear suppuration is caries of the malleus or incus. On p. 304 the writer describes the tensor tympani tendon as the external ligament of the malleus. A notable omission is that of Blegvad's drops for producing anæsthesia of the tympanic membrane.

Loeb and Beck deal with the surgery of the mastoid. This is the best chapter in the book. The authors do not go to extreme lengths in advocating the blood-clot method of healing after the Schwartze operation, and pour cold water on Heath's modified radical mastoid operation. This chapter includes the methods of dealing with the labyrinthine and intracranial complications of middle-ear suppuration. The writers advocate ligation of the internal jugular vein whenever the diagnosis of sinus thrombosis is established or when there is little doubt of its presence. They adopt Neumann's indications for the labyrinth operation and fully describe this operator's method of draining the inner ear, as well as those of Hinsberg, Richards, and Beck. As is only natural, they favour the latter procedure, in which the burr is used to open up the labyrinth. They describe the operation of Haynes and Kopetzky for the drainage of the cisterna magna in cases of purulent meningitis, though this procedure has not yielded the results hoped for.

Taken all over, the work gives a very excellent account of the modern surgery of the nose, pharynx, larynx, and ear. It is well written and illustrated and should be of great value to all Anglo-Saxon otologists and laryngologists.

Treatment of Diabetes Mellitus by Alimentary Rest ("*Allen*" *Treatment*). By O. Leyton, M.D., F.R.C.P.E. Pp. 64. London: Adlard & Son, and West Newman, Ltd. 1917.

The author says this little brochure is not a book. It is really a reprint of three lectures delivered at the London Hospital and already reported in the journals. The method adopted is to get the patient to abstain from food, and to rest in bed till sugar disappears from the urine for twenty-four hours. Then the patient's tolerance for carbohydrate, then for protein, then for fat is ascertained, and he is put and kept on such a combination of alimentary substances which supply enough calories and yet do not bring about the reappearance of glycosuria. The author wisely insists on a careful investigation of the teeth and pancreas, etc., to eliminate causes of glycosuria before treatment is instituted. Exact diet tables are printed and appropriate clinical cases are mentioned to illustrate the points. The author may be said to make out a good case for the extensive trial of the Allen method of dealing with this disease.

Ligations and Amputations. By A. BROCA, Professor of Operative Surgery at the Faculty of Medicine in Paris. Translated by ERNEST WARD, M.D., F.R.C.S. Pp. 285. With 570 Illustrations. Bristol: John Wright & Sons, Ltd. 1917.

THE translator expresses the hope that this modest book may prove useful to English-speaking students of medicine, and of interest to the many whose attention has recently been drawn again to these aspects of operative surgery. The illustrations are the feature of the book and constitute an absolutely first-rate guide to the procedures described. We do not know of any book in which the details of the operations in question can be so easily and accurately followed. The translator's work has been efficiently performed.

The Institutional Care of the Insane in the United States and Canada. By Various Authors. Edited by H. M. HURD, M.D. Vol. IV. Pp. 652. With Numerous Illustrations. Baltimore: The Johns Hopkins Press. 1917.

THIS is the concluding volume of a work, not only praiseworthy and interesting, but of great value to students of the history of social progress, and especially to all concerned with the care of the insane. It treats of Canada alone, and in reading the account of the care bestowed on the insane in each of its provinces one may trace in miniature that country's progress in other and more noteworthy directions. In reading this account the general impression received is that almost from the beginning there was a constant struggle against overcrowding. The influx of population was so rapid that new buildings were hardly occupied before the accommodation was more than taken up. This did not conduce to orderliness of design, and not seldom a destructive fire proved in the end a blessing in disguise, by permitting of well-arranged plans for new quarters being carried out. Another general impression is, that many warning instances are seen of the evils attending the administration of asylums on a political basis. Happily these evils no longer exist.

As was to be expected, the older provinces took the lead in providing proper care for their insane, but some of the newer ones, being unhampered by inconvenient traditions, have little reason to fear comparison with their older rivals. To Quebec belongs the honour of building the first dwelling for the reception and treatment of mental cases. As in many other places, this was in connection with a general hospital, and it remained so for many years, until a separate hospital was built. The influence of Miss Dorothea Dix, which was so powerful a factor in the amelioration of the lot of the insane in the United States, is found in the records of the Nova Scotia asylum, which she

was largely instrumental in getting established. This volume has, as a frontispiece, a reproduction of her portrait, which has an honoured place in the hospital.

In this volume are included the biographies of a large number of individuals who took a prominent part in the history related in the previous and present volumes. The editor and authors may be heartily congratulated on the successful completion of a most interesting and useful work.

Finch and Baines: A Seventeenth-Century Friendship. By ARCHIBALD MALLOCH. Demy 4to. Pp. x. + 90. With Frontispiece and 9 Plates. Cambridge University Press. 1917. Price 10s. 6d. net.

THIS book is interesting in the first place in that it is the work of an officer in the Canadian Army Corps, who in the intervals of duty at a hospital placed in the ancestral home of two seventeenth-century physicians was able to undertake the necessary historical research.

Sir John Finch and Sir Thomas Baines excite a great amount of human interest for the David and Jonathanlike friendship which sprang up during their college days, kept them inseparable in residence at London, Florence, and Constantinople, and was ended only by death, which claimed both within one year.

They led an eventful life, being concerned with the founding of the Royal Society, intimately connected with the University of Padua, where they studied for many years, and with that of Pisa, where Finch was for a time Professor of Anatomy and a colleague of Malpighi and Borelli. Later they were engaged in diplomatic service, Finch being for a time King Charles II.'s "Resident" at the Court of Florence, and later at that of Mahomet IV. in Constantinople.

The book contains extracts from numerous letters between them and friends in England, and it therefore affords interesting sidelights upon social and medical life in various parts of Europe at that time.

The Prevention of Disease: A Popular Treatise. By KENELM WINSLOW, B.A.S., M.D., Washington. Pp. xv. + 348. With 32 Illustrations. Philadelphia and London: W. B. Saunders Co. 1916. Price $1.75.

IF members of the lay public will attempt to maintain a high standard of individual health by the reading of books on medicine, it is well that they should be provided with reliable information presented in intelligible form. This Dr. Winslow has done in his "detailed practical guide for the layman, that he may avoid the various diseases described herein." The diseases range from influenza to dengue, and include

such varied afflictions as lock-jaw, dandruff, bubonic plague, tonsillitis, cancer, obesity, dementia præcox, and mumps. Indeed there is hardly an ill that flesh is heir to that Dr. Winslow does not give guidance in avoiding, and, be it said, his advice is always sound, rational, and reasonably practicable. How far it will enable even his most conscientious readers and followers to escape is another question. We could not honestly advise a valetudinarian to sit down and read it from cover to cover with the assurance that all his fears would be dispelled. It is more than likely that he would only discover dangers that he wist not of, and his last state might be worse than his first. To the citizen of average health of body and mind (who, however, is not so likely to turn to such reading) this work will offer reliable information regarding any disease to which he is specially exposed, and so long as he takes one subject at a time and follows the instructions given, he is likely to benefit by it. This of the individual diseases dealt with. There are several sections on general subjects, such as personal hygiene, the use of tea, coffee, alcohol, and tobacco; and the general question of diet and of exercise, which we commend unreservedly to all. On the subject of the prevention of venereal disease—always a difficult one to present to the lay reader—the author deals with frankness, force, and discrimination.

For works of this kind there is always a certain demand, and the example before us is one of the best we have hitherto met.

NEW EDITIONS.

Diseases of the Genito-Urinary Organs and the Kidney. By Robert Holmes Greene and Harlow Brooks, New York. Fourth Edition. Pp. 666. With 301 Illustrations. Philadelphia and London: W. B. Saunders Co. 1917. Price $5.50.

The advantages of a surgeon and a physician working in collaboration are seen in this comprehensive work on the genito-urinary organs. Dr. Greene is responsible for the surgical matter, and Dr. Brooks for the medical, and between them they have provided for the general practitioner, to whom the work is mainly addressed, a reliable guide to the modern aspects of the subject. This, the fourth, edition has been thoroughly revised, and much recent work has been incorporated.

The authors rightly insist on the importance of a thorough and methodical investigation of all patients suffering from lesions of the urinary tract, but it is surely pedantic to lay down the rule that the patient should be questioned "concerning the symptoms complained of in the upper extremities, and so to continue on down the body to the

soles of the feet." Why the head and neck should be thus positively excluded is not evident. Many signs of renal disease have their seat there, as the authors suggest a few pages further on, and emphasise by including a special chapter, from the pen of Dr. Richard Kalish, on the ocular manifestations of renal diseases.

The laboratory methods of investigation are described fully without over-elaboration, and the various methods of examination by endoscopic means are satisfactorily dealt with.

We do not always agree with the authors in the selection they make of operative procedures for detailed description, but as they only profess to give the methods of which they have had personal experience of a satisfactory kind there is no ground for complaint in this.

A number of illustrations are excellent but others fall below the standard to which we have become accustomed in the publications of American writers. There is a full index.

The Intensive Treatment of Syphilis and Locomotor Ataxia by Aachen Methods. By REGINALD HAYES, M.R.C.S. Second Edition. Pp. 88. London: Baillière, Tindall & Cox. 1917. Price 3s. 6d. net.

BY the Aachen methods the author means "the inunction of a $33\frac{1}{3}$ per cent. mercurial ointment by the bare hands of a skilled rubber under proper medical supervision, and, in addition, the use of sulphur water internally and externally as administered at Aachen." The relative value of inunction as compared with other modes of mercurial administration is indicated, the technique as carried out at Aachen is described, the contra-indications to mercurial treatment are pointed out, and a number of cases illustrating the results of the Aachen methods are reported. The treatment, as the author points out, can be carried out equally effectively in this country.

The Treatment of Diabetes Mellitus. By ELLIOTT P. JOSLIN, M.D. (Harv.), M.A.(Yale). Second Edition. Pp. 559. With 10 Illustrations. Philadelphia: Lea & Febiger. 1917. Price $4.50.

THAT a second edition of this book has been called for so soon after its first appearance is a testimony to its excellence that a perusal readily endorses.

It embodies the suggestions of F. M. Allen of the Rockefeller Institute for the treatment by alimentary rest of patients suffering from

diabetes mellitus—a treatment based upon experimental work, laborious in character but of the utmost significance and importance.

The former somewhat haphazard treatment of this disease has now been raised more to the level of a scientific procedure, for the conduct of which the physician must make himself as well acquainted with the qualitative and quantitative composition of foods as he is with drugs, and must be able to prescribe and combine them with the same facility. The arrangement of the book into its seven sections is excellent, and the masterly manner in which Joslin arrays his observations, monumental in quantity as well as in importance, succeeds in convincing without confusing.

Particular mention might be made of his account in Section II. of the nature of the diabetic acidosis and its relation to coma, and in his treatment against acid intoxication convincing facts are furnished in support of his practice of not giving alkalies in the presence of threatening coma.

Joslin contends that the great risks of onset of acidosis, which was an only too common and fatal sequela of the inauguration of strict diabetic treatment on the old lines, can now be almost completely obviated at all ages by following his suggestions, and if these claims can be substantiated by independent observers, an enormous step will have been taken in our advance in treatment.

Joslin gives very instructive reports of the numerous cases quoted, with elaborate data regarding their individual treatment, and a record of the subsequent history of cases mentioned in the earlier edition increases the value of the volume.

Section VI., which is devoted to a compendious guide in the practice and management of diabetic cases, is also worth special notice ; likewise the most elaborate tables of actual and relative food values, without an exact knowledge of which modern treatment could not be accomplished. The author takes a foremost place among that able body of American physicians who have done so much in the last few years to advance our knowledge and enhance our skill in the treatment of a disease of the origin of which we are still in ignorance.

NOTES ON BOOKS.

Two useful additions have been made to Messrs. Methuen's Health Series—*Tuberculosis and how to Avoid it*, by Clive Riviere, M.D., and *Staying the Plague*, by N. Bishop Harman, M.A., M.B.(Cantab.) (Methuen & Co., price 1s. net). These works are addressed to the lay reader, and give in simple language a clear exposition of the subjects dealt with. We commend them specially to welfare workers. Dr.

Harman's contribution will prove particularly useful at this time when the crusade against venereal disease is getting under way, as it contains an excellent summary of the Royal Commission's report and a judiciously considered statement of the whole problem.

The Ideal Nurse (The Mental Culture Enterprise, price 1s. 3d. net) is an address delivered in 1909 by Dr. Charles A. Mercier to "nurses who devote themselves to nursing the mad." It was characterised by the late Sir Thomas Clouston as "masterly," which is sufficient praise.

Health in Camp, by Austin K. Nankivell (Constable, price 1s. net), is an excellent example of the endless series of booklets that the war has called forth. It is obviously written from practical experience.

Electro-therapeutics for Military Hospitals, by Captain Wilfrid Garton, R.A.M.C. (H. K. Lewis & Co., price 2s. 6d. net), reflects the author's experience of electric treatment during two years he has served in the R.A.M.C.

Chambers' Income-Tax Guide, by John Burns, W.S. (W. & R. Chambers, Ltd., price 1s. 6d. net), is well worth the money. It deals with the limits of tax liability, how to fill up forms, how to secure abatements, and how to obtain repayments.

Dr. E. G. Younger's *Insanity in Everyday Practice* (Baillière, Tindall & Cox, 1917, price 5s. net), now in its fourth edition, is a very sound compendium of practical chapters on the causes and early symptoms of insanity, the doctor's interview with his patient, and the legal bearings of the subject. The various forms, typical and special, are dealt with in detail, treatment being indicated where possible. A note on neurasthenia and Freudism is added. We highly recommend the volume.

Therapeutic Immunisation, by W. M. Crofton, M.D. (J. & A. Churchill, price 7s. 6d.), is published as a brief exposition of the case for vaccine therapy, supported, as the author claims, by highly satisfactory results in practice. The early chapters deal with the different mechanisms of immunity, and the later with the prevention and treatment of infection in detail. Many valuable hints in application are to be found in the pages, which are well written and clearly printed.

The Venereal Diseases Problem (Baillière, Tindall & Cox), by J. K. Watson, is mainly addressed to nurses and midwives, and successfully supplies such information as they require on this all-important subject.

Dorland's American Illustrated Medical Dictionary (W. B. Saunders Co., price 21s.) is so well known and so highly valued that it is only necessary for us to record the appearance of the ninth edition, which contains no fewer than 2000 new terms. As a work of reference it is indispensable.

A collection of food recipes suitable for infants and young children forms the major part of Dr. Abt's *The Baby's Food* (W. B. Saunders Co., 1917, 6s. net). The recipes ring the usual changes on cereals,

zwieback, and junket, and there are five ways of cooking oysters, which may be broiled, roasted, stewed, panned, or steamed, but never fried. Evidently young America is not rationed yet.

The good features which have always characterised the Willance *Photographic Exposure Record and Diary* are, if anything, enhanced in the 1918 issue, which has just appeared. The main article has been entirely rewritten, and is a remarkable exposition of successful photographic practice. It is so written that the veriest tyro can follow it, yet few experienced photographers will read it without profit. Unquestionably this is one of the most useful photographic annuals. A sign of the times is the attention this firm are paying to new developers, which will in the future, we hope, replace those of German make.

The Surgical Operations on President Cleveland in 1893 (George W. Jacobs & Co.) is an authentic record by Dr. W. W. Keen of the historical removal of the maxilla for sarcoma, performed in secrecy on board the yacht *Onieda* by Joseph D. Bryant while the American financial crisis was at its height, and when Mr. Cleveland was about all that stood between the United States and absolute disaster.

In *Electro-Therapeutics for Military Hospitals* (H. K. Lewis & Co., Ltd., price 2s. 6d.) Dr. Wilfrid Garton records his experience in electrotherapy gained during two years' service in the R.A.M.C., and enters a cogent plea for more extensive use of electrical treatment of the effects of injury and disease amongst soldiers.

Dr. H. R. Kenwood's *Health in the Camp* (H. K. Lewis & Co., Ltd., 3d. net) is a useful little pamphlet which gives in a simple way a great deal of sensible advice on camp and personal hygiene. It deserves to be widely distributed and read.

Dr. Chalmers Watson's *Lectures on Medicine for Nurses* (E. & S. Livingstone, 1917, 4s. 6d. net) contains all, and more than all, that a nurse need know about medicine. The substance of the book consists of lectures and cliniques delivered to nurses at the Royal Infirmary, and the extent to which they were appreciated has led the author to publish them in book form.

In his *Elementary Hygiene for Nurses* (J. & A. Churchill, 1917, price 3s. net) Dr. Rutherford Darling gives us a useful epitome of the elements of hygiene—ventilation, warming, food, water, sanitation, infectious diseases, parasites, etc.—with all of which a nurse ought to have at least a bowing acquaintance. Indeed, considering the amount of preventive medicine which even now falls within the duties of nurses, and the prospect there is that their work along these lines will increase, we believe that a book of this kind is much more suitable mental pabulum for a nurse than one which deals with problems in pathology or minutiæ of anatomy and physiology. The book seems to us altogether good.

ANALYTICAL REPORTS.

BROMIDE PAPER FOR X-RAY WORK.

(THOMAS ILLINGWORTH & Co.)

MESSRS. THOMAS ILLINGWORTH & Co., the well-known manufacturers of photographic printing papers, have forwarded us samples of their special bromide and gas-light paper for X-ray work. Each of these is made in two grades, for average and for thin negatives respectively. These papers appear to us well adapted for X-ray work. They allow of considerable latitude of exposure, and give clear vigorous prints free from stains. The bromide paper gives equally good results with amidol or metol-hydrokinone, while with the gas-light paper, instead of using the ordinary strong M. Q. developer, we found it if anything simpler to use the more dilute solution, by which control of development is somewhat easier. An additional point in favour of these products is that they can be developed with Messrs. Johnson & Sons special X-ray plate developer, which gives excellent prints with plenty of detail. As in many hospitals the above is at present the only developer in use, this is a considerable advantage. We consider that these papers fulfil all that their makers claim for them.

"HYPOLOID" SCOPOLAMINE HYDROBROMIDE.

(BURROUGHS WELLCOME & Co.)

In view of the increasing application of scopolamine-morphine narcosis, Messrs. Burroughs Wellcome & Co. have added to their list two strengths, gr. $\frac{1}{150}$ and gr. $\frac{1}{450}$, of pure scopolamine hydrobromide presented in 0·5 c.c. sterile solution. The convenience of the "Hypoloid" product is that the precise dose of medicament in sterile solution is ready in a hermetically sealed glass phial when required for use, and the physician is thus ensured of using an accurate sterile dose of the pure drug with the minimum of trouble.

The new strengths are those usually employed—gr. $\frac{1}{150}$ as an initial injection and gr. $\frac{1}{450}$ for subsequent use.

BOOKS RECEIVED.

ALCOHOL: Its Action on the Human Organism . . . . . (*H.M. Stationery Office*) 2s. 6d.
CAMPBELL, HARRY. The Biological Aspects of Warfare . (*Bailliere, Tindall & Cox*) 1s.
DENMAN, THOMAS. The Discharged Consumptive Soldier (*John Bale, Sons & Danielsson, Ltd.*) 1s.
DRUMMOND, MARGARET. The Dawn of Mind . . . . . . (*Edwin Arnold*) 3s. 6d.
ELLIOT, R. H. Glaucoma: A Text-Book for the Student of Ophthalmology (*H. K. Lewis & Co., Ltd.*) 21s.
HARTZELL, MILTON B. Diseases of the Skin: Their Pathology and Treatment (*J. B. Lippincott Co.*) —
KIRKPATRICK, T. PERCY C. Nursing Ethics. Second Impression (*University Press, Dublin*) —
MILES, ALEXANDER. The Edinburgh School of Surgery before Lister . . (*A. & C. Black*) 5s.
MOOR, C. G., and E. A. COOPER. Field Sanitation . . (*Bailliere, Tindall & Cox*) 2s. 6d.
STIMSON, LEWIS A. Fractures and Dislocations (*Dea & Febiger, New York and Philadelphia*) 6 dols.
TAYLOR, Sir FREDERICK. The Practice of Medicine. Eleventh Edition (*J. & A. Churchill*) 24s.

The PROFESSIONS and "PELMANISM."

No professional body is more reserved in its judgments than members of the legal profession. It is, therefore, of especial significance to note the emphasis with which Pelmanism has been praised by Barristers and Solicitors, as well as by Judges and other legal officials.

Several typical letters are given here. The first is from a Judge, who writes :—

"The Pelman System, as I have seen it so far, seems to me of the very greatest use. Even if a person had, at some time or other, thought of all the things contained in the books, the fact that they have been put down consecutively and in the form of 'lessons' is of great value. Again, the very fact that one is 'walking hand-in-hand' with a teacher causes one to pay increased attention to one's steps. Since starting the Course my mind has hardly one idle moment."

The writer of the foregoing letter obviously has in mind that a man may study psychology *as a science* without tangible gain. That is due to the care with which psychological writers, as a whole, divorce the subject from everyday life. They glory in technology and revel in abstract speculation. But the busy professional mind cannot afford the time for merely speculative study. A practical exposition of psychology in direct touch with workaday life—such as Pelmanism is —appeals where the strictly "scientific" treatise would not. Besides which, the material results reported by Pelmanists are sufficient to convince even the most sceptical mind of the thoroughly practical character of the study.

A Solicitor—an LL.B.—expresses himself with equal emphasis :—

"I have never yet come across any set of books upon any subject so clearly arranged, so full of matter, and so absolutely devoid of any *irrelevancies* as these books. The mere perusal and mastery of them is, I am sure, an intellectual exercise of the highest order. I have most thoroughly enjoyed the work."

An Irish Barrister writes :—

"In returning Lesson Five I would wish to say how interesting that lesson has been to me. It is most valuable and suggestive. I have read largely concerning the question with which it deals, but I have never seen the essentials so convincingly put. . . . I am more than pleased with the Course so far."

A Doctor's Discovery.

Medical men have very largely adopted the Pelman System, and many interesting communications are received from them. Here is one

which speaks in very precise terms of a very substantial gain due to Pelmanism :—

> "I took the Pelman Course because my practice was not in a satisfactory condition, and I could not discover the cause. Your lessons enabled me to analyse the trouble, discover the weak points, and correct them, with most satisfactory results. Your Course has proved to be a splendid investment for me. My chief regret is that I did not take it at the beginning of my student days."

An Architect writes :—

> "The benefits derived from the Course are inestimable. A Pelman student is equipped with a wonderful stock of information and devices that cannot fail to help him to get the best out of *any* problem in life. I consider the lesson on Personality is alone worth the whole fee. My position has undoubtedly improved, both socially and financially, since I took the Course."

And, as a concluding example of the universality of the benefits of Pelmanism, we quote from the letter of an Artist :—

> "The results are wonderful. When reading through the testimonials before taking up the Course I wondered if there was any possible exaggeration. But honestly, no pen can express one tittle of the value the Course really is. What I have gained up to the present (Lesson 2), could never be called costly, even had I paid £50."

"Truth's" Verdict.

It is the constant receipt of hundreds of letters like the foregoing which justify—and more than justify—every claim made for Pelmanism, and also *Truth's* famous verdict that—

> **"The Pelman System places the means of progress within the reach of everyone. It does not provide a brain for the brainless, but it does provide everyone with the means of making the best use of the faculties with which nature has endowed him and bringing them to full fruition."**

In view of the enormous mass of positive testimony, every professional man should, at all events, investigate the subject. The System is fully explained and described in "Mind and Memory" (which contains a synopsis of the Twelve Lessons), and a free copy of this interesting booklet, with a copy of *Truth's* remarkable report on the work of the Pelman Institute (which *Truth* declares to be "of national importance") will be sent, *gratis and post free*, to any reader of the *Edinburgh Medical Journal* who addresses a request to the Pelman Institute, 217, Wenham House, Bloomsbury Street, London, W.C. 1.

EDINBURGH MEDICAL JOURNAL.

EDITORIAL NOTES.

CASUALTIES.

DIED on service, Staff-Surgeon GEORGE ROBERTSON MILL.

Staff-Surgeon Mill, who graduated M.B., Ch.B. at Edinburgh University in 1901, and M.D. in 1905, was in practice at Birkenhead, where he held several hospital appointments.

LOST at sea, Captain GERALD WILLIAM YOUNG, R.A.M.C.

Captain Young, who was lost with the hospital ship *Glenart Castle* on 26th February, graduated M.B., Ch.B. at Edinburgh University in 1903, and M.D. in 1907.

STUDENTS OF MEDICINE.

KILLED in action on 11th February, Surgeon-Probationer DAVID JOHN WHITTON, R.N.V.R.

Mr. Whitton was a third-year student of medicine in Edinburgh University.

ACCIDENTALLY killed on 6th February, while on active service, Gunner P. G. HENDRY, Royal Garrison Artillery.

Gunner Hendry was a medical student in Edinburgh University before joining the Army.

Appointment. DR. J. S. FOWLER has been appointed Senior Physician to the Royal Hospital for Sick Children *vice* Dr. John Thomson, resigned.

Dental Passes. AT the recent Dental Examinations of the Royal College of Surgeons of Edinburgh the following candidates passed the Final Examination and were granted the Diploma L.D.S., R.C.S.(Edin.):—Alexander Brunton Wallace, Edinburgh; James Sylver Butchart, Leith; Alfred M'Cambley, Belfast; and Daniel Andries Marchand, South Africa.

CLINICAL STUDIES. XIV.—"CROSSED" APHASIA; MIRROR WRITING.

By BYROM BRAMWELL, M.D., F.R.C.P.E., LL.D., F.R.S.E., Consulting Physician, Royal Infirmary, Edinburgh; Physician, Chalmers Hospital, Edinburgh.

In the *Lancet*, 2nd June 1899, I recorded a case (Case I.) in which a sudden vascular cerebral lesion (apparently embolism of the left middle cerebral artery) *in a left-handed man, who from birth had been strongly left-handed, but who had been taught to write only with the right hand, and none of whose ancestors had been left-handed, produced right-sided hemiplegia and marked and persistent aphasia (very marked motor aphasia, some word-deafness, and considerable word-blindness and agraphia).* I termed the condition "crossed" aphasia. In that paper and in a subsequent communication, published in the *Edinburgh Medical Journal*, May 1916, I considered in detail the explanation of "crossed" aphasia, and pointed out that to understand the subject it is essential to remember that:—

1. The vast majority of mankind use one hand more than the other, *i.e.* are either right-handed or left-handed.

2. The great majority of persons are right-handed, a small minority, probably about 2 per cent. of the whole, being strongly left-handed.

3. The ancestors of the great majority of persons have for generations been right-handed, and, consequently, (*a*) heredity, (*b*) congenital or organic aptitude, and (*c*) actual acquirement (habit, example, social usage, and education) all tend to make the majority of persons right-handed.

It therefore follows that in right-handed persons the left hemisphere, and in left-handed persons the right hemisphere, is the "leading" or "driving" side (hemisphere) of the brain.

4. With rare exceptions the "leading" or "driving" *speech* centres are situated in the hemisphere of the brain, which is, so far as the movements of the hand are concerned, the "leading" or "driving" side.

Consequently, acute and complete destruction of the left motor-vocal speech area, when it occurs in a right-handed man, in the vast majority of cases, produces motor-vocal aphasia; while the same lesion, when it occurs in a left-handed man, does not, in most cases, produce motor-vocal aphasia. *Vice versâ*, acute

and complete destruction of the motor-vocal speech area in the right hemisphere of the brain, when it occurs in a left-handed man, in most cases produces motor-vocal aphasia; while the same lesion, when it occurs in a right-handed man, does not, in the vast majority of cases, produce motor-vocal aphasia—I mean marked and persisting, and not merely temporary, motor-vocal aphasia.

For the sake of simplicity I limited my remarks to motor-vocal aphasia, but the same statement may be applied, though not perhaps quite so forcibly, to the sensory varieties of aphasia. Further, the same statement does not apply so forcibly to agraphia, at all events to cases in which left-handed persons have been taught to write only with the right hand, and have been in the habit of writing only with the right hand. It is probable, I think, that in some cases of this kind (left-handers who write only with the right hand) lesions of the right hemisphere do not produce agraphia or, indeed, aphasia of any kind, because the act of writing with the right hand tends to make the *left* hemisphere the "leading" or "driving" side, so far as the speech functions are concerned.

Exceptions to these statements occasionally occur. In the vast majority of cases of "crossed" aphasia the speech defect is merely temporary and evanescent. Cases of temporary "crossed" aphasia are easily enough explained if it be granted, as I have long contended, that the cortical centres, or perhaps it would be more accurate to say the cortical speech area,* in the "non-leading" or "non-driving" hemisphere corresponding to the speech centres or area in the "leading" or "driving" hemisphere of the brain, are possessed of some sort of speech function, which is usually, I think, carried on in conjunction with, and in subordination to, the function of the speech centres or area in the right or "driving" side. In cases of this kind the aphasic symptoms usually pass off in the course of a few days.

Cases of persistent and permanent "crossed" aphasia, such as that which I recorded in the *Lancet* in 1899, are rare. They usually seem to occur in left-handed persons, very exceptionally in right-handed persons. In my paper in the *Edinburgh Medical Journal* of May 1916 I recorded an exceptional case of this kind (Case II.) in which an embolism of the right middle cerebral artery produced *left hemiplegia and complete motor aphasia in a*

* Recent observations seem to show that the motor-vocal speech centre or area is more extensive than Broca originally supposed.

right-handed person who had always been right-handed and none of whose relatives had, so far as is known, been left-handed.

In my original paper on the subject I pointed out that in right-handed persons, in whom the location of the fundamental speech centres or area, as "leading" speech centres, in the left hemisphere has already been determined by heredity, organic aptitude, and actual acquirement, the fact that they are taught to write with the right hand (if it has any action at all) will merely confirm and strengthen this localisation. But I suggested that in left-handed persons whose ancestors were right-handed the fact that they have been taught to write, and have only been in the habit of writing, with the right hand, can perhaps upset this (prior) localisation—*i.e.* can re-transfer the "leading" speech centres or area to the right hemisphere.

It seems to me that in left-handed persons whose ancestors have been right-handed the question whether the "leading" or "driving" speech centres or area are located in the right or in the left hemisphere of the brain will, at all events prior to the time when they are trained to write with the right hand, chiefly depend upon the fact whether the hereditary influence which favours the location of the speech centres or area in the left hemisphere or the acquired influence, due to the left-handedness which favours their location in the right hemisphere, is the more potent; and I am disposed to think that, in most cases at all events, the latter factor will be the more powerful. But it is not difficult to conceive that in some cases (left-handed persons whose ancestors were right-handed) these factors—heredity and actual acquirement—will, so far as the location of the speech centres or area is concerned, be more evenly balanced than in the majority of persons, and that up to the time when the child begins to read and write the location of the speech centres or area as the "leading" speech centres in the right hemisphere (even granting that the influence of the acquired left-handedness is more potent than the influence of heredity) will not be so firmly fixed as in the majority of persons. In such cases it is not, I think, unreasonable to conclude that the introduction of a third factor, viz. the learning to write with the right hand, and the habit of writing only with the right hand, may be sufficient to turn the scale and to determine that the "leading" or "driving" speech centres or area shall be finally located in the left hemisphere.

The same statement applies even more forcibly to left-handed persons who have by training and constant practice become

bimanual. In left-handed persons who have by practice become bimanual and are in the habit of using the right hand as freely as the left, a lesion in the right hemisphere of the brain, which involves the speech centres, will, I think, be less likely to produce aphasia than in strongly left-handed persons who are not bimanual. The following is a case in point:—

CASE III.—An enormous tumour destroyed the whole of the frontal lobe, the speech centres, and the subcortical tissue below the speech centres in the right hemisphere of the brain; the mental faculties remained quite alert and active; there was no aphasia and no agraphia. The patient was naturally left-handed, but in reality bimanual; he wrote with his right hand and used the right hand for fine work. It is probable, therefore, that in him the speech centres were located, as they usually are in right-handed persons, in the left hemisphere of the brain, or were bilaterally much more active than they usually are in the majority of left-handed persons, *i.e.* left-handers who are not bimanual. Hence there is no difficulty in understanding that a slow-growing tumour which produces gradual destruction of the right hemisphere of the brain and of the speech centres in it—the "leading" or "driving" side—would in this patient be less likely to be attended with definite aphasic symptoms—motor-vocal aphasia or agraphia—than in the majority of strongly left-handed people. The case is fully reported in my *Clinical Studies* (vol. v. p. 157).

But if this supposition regarding what I term *the third factor* is correct in some cases, such cases are perhaps exceptional. The following case shows this:—

CASE IV.—A man, aged 58, was admitted to Chalmers Hospital on 17th April 1917 suffering from complete aphasia and left-sided hemiplegia. The patient from birth had been strongly left-handed, but he had been taught to write with, and had been in the habit of writing only with, the right hand; he could, however, write with the left hand, but had not been in the habit of doing so. None of his relations or ancestors had been left-handed.

The patient had enjoyed good health until May 1916, when he had an epileptic fit. After this he began to suffer from headache, occasional vomiting, and giddiness. He worked up till 17th March 1917—a month before his admission to hospital. The headache at times had been severe. When admitted to hospital there was very marked double optic neuritis. The left side of the face, the left arm, and the left leg were paralysed.

The diagnosis was a tumour of the right cerebral hemisphere, involving the motor area and speech centres, or the subcortex below these centres.

As regards the speech functions. The patient was perfectly conscious and apparently intelligent, but he was markedly aphasic (complete motor aphasia, very marked word-deafness, apparently complete word-blindness, and agraphia). There was no paralysis of the right hand, with which he had been in the habit of writing. He could use the right hand for ordinary manipulations, but although he had attempted to write with the right hand he had not done so for four weeks prior to his admission to hospital. Up to 17th March 1917 (when he left off work) he had been in the habit of writing a good deal.

After his admission to hospital his ability to read and write was carefully tested. On one occasion on which he was told to write his name he wrote down "James Livie" quite correctly; the letters were perfectly formed; there was no defect in the production of the letters; the writing resembled his ordinary signature when in health. On various other occasions, when he was asked to write and told to write down definite things, he invariably failed to do so; on more than one occasion he wrote gibberish—a series of meaningless letters and (?) words, the individual letters being perfectly formed.

The patient died on 12th May 1917, a month after his admission to hospital.

Post-mortem examination showed a very large tumour situated in the right hemisphere of the brain. It had apparently commenced in the subcortical white matter below the temporo-sphenoidal lobe, and had cut off or destroyed the whole of the speech area (cortex of the second and third frontal, the first and second upper temporal convolutions, and the angular gyrus on the right side).

The importance of the case is that a man who was strongly left-handed from birth and who had been in the habit of writing only with the right hand, as the result of a large tumour of the right cerebral hemisphere became affected with left-sided hemiplegia and complete motor and sensory aphasia, and that *although there was no paralysis of the right hand, he was affected with very marked agraphia, i.e.* unable to write with the non-paralysed right hand. The case seems to show that in some left-handed persons who have been taught to write with the right hand, and only in the habit of writing with the right hand, the *stimulus for the act of writing,* which ultimately reaches and sets in action the motor centres for the right hand in the left hemisphere of the brain, *has its origin in a sensory centre or centres on the right or "driving" side of the brain.*

In this connection the question of "mirror reading" and "mirror writing" is of great interest and importance.

In my *Clinical Studies* (vol. viii. p. 370) I have recorded a case

in which a boy who was naturally left-handed, and who, for some years after he had learned to read and write, read and wrote in the opposite direction to the normal ("mirror reading" and "mirror writing").

Case V.—The patient, aged 17, was seen on 18th April 1898, suffering from ordinary idiopathic epilepsy.

History.—When teething he had several convulsions; when 2½ years old he had an epileptic fit, which was thought to be due to eating an indigestible meal; at the age of 13½ he had another epileptic fit; he has had four or five since—the last occurred eight weeks ago.

Family History.—Two half-cousins (daughters of his father's half-sister) are epileptics.

Present Condition.—The patient is perfectly well in every respect except for the occasional epileptic attacks.

Mirror Reading and Mirror Writing in Early Life.—He is naturally left-handed. None of his relatives are left-handed. He writes, and has been trained to do so, only with his right hand.

When he began to read, he read everything backwards, from right to left, *e.g. God* was read as *dog.* This "mirror reading" was with great difficulty overcome; he did not read in the ordinary way (from left to right), *i.e.* did not completely lose the "mirror reading," till between 6 and 7 years old.

He began to write at the age of 5, and then wrote from right to left ("mirror writing"); he was with great difficulty taught to write in the ordinary way (from left to right).

Since the age of 7 the "mirror reading" and "mirror writing" have disappeared; he always reads and writes now in the ordinary way (from left to right). He read and wrote fluently in my presence in a perfectly normal way.

If one takes a pencil in each hand and then writes simultaneously with the two hands on a sheet of paper, it will be found that one writes from left to right with the right hand and from right to left with the left hand—one writes outwards from the centre of the body with each hand. And if one compares the two writings—if one is able to write easily in this way with the two hands—it will be seen that they are absolutely identical—the "mirror writing" (written with the left hand), if reversed and placed, for the purpose of comparison, above the writing written with the right hand, is found to be identical, stroke for stroke, with the writing of the right hand. If one is an expert writer in this way, with the right and left hands simultaneously, and one makes a series of flourishes and curves, every curve and flourish will be found to be identical in the two writings. This seems to

show that the motor discharge which produces the movements necessary for the act of writing is identical in character on the two sides of the brain (in the two hand centres). Presumably, therefore, both motor discharges are stimulated and governed from the same sensory centre, which, in right-handed persons, is presumably situated in the left, and in left-handed persons in the right, hemisphere.

When we will a movement we must first raise up in the sensorium the idea of that movement. Now the idea of a movement consists in the revival, either consciously, subconsciously, or unconsciously, of the sensory impressions which attend the production of that movement. These impressions are (or may be) of two kinds, viz. (1) the visual, auditory, or other impressions which, so to speak, indirectly result (or may indirectly result) from the production of the movement—these impressions are revived in the visual, auditory, or other sensory centres in which they were originally perceived and registered; and (2) the kinæsthetic impressions, which directly result from the production of the movement—these impressions are revived in the kinæsthetic centre or centres.

In willing to perform a writing movement or a series of writing movements, we first revive the idea of the movement. We think of the movement which we wish to make; this consists in the revival, either consciously, subconsciously, or unconsciously, of the sensory impressions (visual and kinæsthetic) which attend the production of the movement — the visuo-kinæsthetic or the ideatory-kinæsthetic memory of the graphic movements, as it may be termed—sensory impressions which have, so to speak, been registered and implanted in the visual and kinæsthetic centres, by the former production and repetition of the movement (by learning and practising the writing movements concerned). The stimulus which is generated by the revival of these impressions ultimately passes to the cortical centres for the movements of the fingers, forearm, etc.

As I have already stated, the identical character of the two writings, written simultaneously with the right and left hands, seems to me to show that this simultaneous discharge of the two motor writing centres in the left and right sides of the brain must have been stimulated and governed by the same sensory discharge, *i.e.* by the discharge of the visual (and perhaps also the kinæsthetic centre, or both—ideatory-kinæsthetic—centres) on *one*, probably the left (the active), side of the brain.

CHEMOTHERAPY IN PNEUMONIA.

By EDWIN MATTHEW, M.A., M.D., F.R.C.P.

In the eleven months February to December 1917 twenty-four cases of lobar pneumonia were admitted to the medical wards of Leith Hospital. The usual expectant treatment of this common and serious condition is often unsatisfactory and the mortality is large. Any successful substitute or any additional help would naturally strengthen our confidence in those cases where we are so helpless in either obtaining a cure or even giving relief. All the twenty-four cases were treated with quinine urea hydrochloride. The action and effects of this drug in pneumonia are interesting in themselves, and the results will bear comparison with those where the treatment has been along the usual recognised lines. Its use does not preclude any therapeutic measures hitherto employed, but in my experience there can be little doubt that cases are saved where the evidence indicated little chance of recovery, and, in addition, in all cases the disease runs a course with much less discomfort and distress to the patient.

Three advances have been made in very recent years in the ætiology and treatment of pneumonia: (1) It has been definitely established that pneumococci can be grouped under four distinct types—I., II., III., IV.—and that each case of pneumonia as it occurs can be placed in its definite group, and, in addition, a definite incidence has been established for these four types. (2) Following upon this the manufacture and use of specific sera have met with increased success, more particularly in pneumonias due to types I. and II., and in all probability specific sera will in time be universally and successfully employed. (3) Decided successes in treatment have been obtained with certain synthetic drugs. The more recent clinical and experimental investigations in chemotherapy for pneumonia have centred round camphor and derivatives of quinine, and the latter especially, as a definite treatment of pneumonia, promise success far exceeding that with the ordinary expectant methods.

Camphor stimulates the circulation, and experimentally has been proved to have a bactericidal action on pneumococci. By its administration in oil subcutaneously and given every two hours it is claimed that pneumonia cases do better. I have employed it in about twenty cases, but so far have failed to be satisfied that the course or termination of the disease was in any way affected.

Quinine and its derivatives hold out better promise of success. Various preparations have been employed experimentally and in actual cases — quinine itself, hydrochinon, quinine urea hydrochloride, ethylhydrocuprein (trade name optochin), and propylhydrocuprein. All of these, it has been found experimentally, exercise a distinct germicidal action upon the various types of pneumococci. The most successful results have been got with optochin, either alone or in combination with a specific serum—the effect of a single dose of the drug greatly increasing the action of a homologous serum. Optochin unfortunately may produce toxic effects, chiefly on sight (total blindness) and hearing. No untoward effects, on the other hand, follow the use of quinine urea, even in large and repeated doses.

Quinine Urea Hydrochloride.—All the twenty-four cases of the series were given quinine urea on admission, irrespective of the day of admission or their condition. Quinine urea is a soluble substance and, being non-irritating, is suitable for intramuscular injection. The injections were made in the buttocks. Large doses were given—15 grs. every three hours for as many times as seemed necessary—and as cases of pneumonia vary so much in their severity, no definite statement can be made as to the number of doses required. One is guided entirely by the condition of the patient and partly by the temperature. All the cases but one had 3 doses in the first nine hours after admission. If after these initial doses the temperature again rises above 102° F., the drug should be continued every three hours as before. Administration should be begun at once, and undoubtedly the best results were obtained in cases admitted early in the disease.

One case of the series had only 2 doses; five cases 3 doses; four cases 4 doses; six cases 6 doses; two cases 8 doses; three cases 9 doses; two cases 10 doses; and one case as many as 22 doses. No toxic effects were produced in any case.

Effects of Quinine Urea.—The immediate effect after two or three injections of quinine urea is a marked fall in the temperature in almost all cases. The fall is usually very considerable and may be to subnormal, and takes place within about eight hours after the second or third injection. It is accompanied by a corresponding fall in pulse and respiration rate, and the patient's symptoms are markedly relieved.

In three of the cases after two and three injections there was no subsequent rise and the pneumonia aborted. If no fall in temperature results, or if the temperature rises again, the injections are

continued. When it does rise again it in most cases fails to reach the previous temperature, and it can be readily seen from the condition of the patient that the disease has been rendered much less severe. The drug, however, should be continued until a crisis is reached. Of the twenty-four cases, twenty-two recovered and two died. One had the crisis on the third day of the disease, one on the fourth, two on the fifth, two on the sixth, and nine on the seventh day. All these cases were admitted on the first or second day of the attack. Four had a crisis on the ninth day, one on the eleventh and one on the twelfth, and in one case recovery was by lysis. These cases were admitted about the fourth and fifth days of the disease, and all were extremely ill on admission. It is a justifiable argument that the same end results might have been attained with the ordinary expectant treatment of pneumonia. Even if this be granted, there are undoubted benefits derived from the use of quinine urea which are observed during the course of the disease, and these alone would justify its use. Four of the cases were extremely delirious on admission, very restless, and looking very ill. After three injections of quinine urea they became quite quiet and sensible, and all toxic phenomena had disappeared.

In all cases the breathing becomes much easier, and all irritability and restlessness is checked. The distressing cough of pneumonia is relieved. Sleeplessness disappears, and in only a very few cases are hypnotics required. The patients require much less nursing attention and the convalescence is quick, the involved lung clearing up very quickly. The blood-pressure is always well maintained.

Mortality.—The admissions of lobar pneumonia to Leith Hospital in successive years varies from twenty-five to thirty-five. For purposes of comparison the admission and fatalities for the seven years previous to 1917 are given :—

	Admissions.	Deaths.	Percentage.
1917 (Quinine urea cases)	24	2	8·3
1916 (Expectant treatment)	31	4	12·8
1915	26	8	30
1914	27	5	18·5
1913	36	6	16·6
1912	23	5	20·7
1911	23	3	13
1910	24	7	29

During the present month—January 1918—three cases of

pneumonia have been admitted to Leith Hospital. All were treated with quinine urea and recovered.

A brief *résumé* of the cases will indicate the salient features of each.

CASE I.—Admitted third day of disease. Six injections. Temperature 103·4°; fell to normal after three injections; rose to 100·4°, and had crisis on seventh day.

CASE II.—Admitted second day of disease. Temperature 105° F. Three injections; crisis next day.

CASE III.—Admitted seventh day of disease. Delirious and had to be strapped down. After 3 doses became quite quiet and remained so. Double basal pneumonia. Ten injections. Developed acute œdema of both lungs; died on seventeenth day.

CASE IV.—Admitted fourth day of disease in a filthy condition. Very cyanosed, extreme dyspnœa. Four injections in twelve hours; crisis next day.

CASE V.—Admitted second day of disease. Temperature 102·4°; respirations 56; pulse 136. Two injections; crisis on fourth day.

CASE VI.—Admitted second day of disease. Four injections; crisis on fifth day.

CASE VII.—Admitted second day of disease. Nine injections; crisis on seventh day.

CASE VIII.—Admitted seventh day of disease. Nine injections; crisis on ninth day.

CASE IX.—Admitted fifth day of disease. Three injections; crisis on seventh day.

CASE X.—Admitted on second day of disease. Very ill and drowsy. Temperature 104°; respirations 44; pulse 142. Prune juice sputum with bad odour. Two injections, followed by rapid fall of temperature to subnormal; temperature rose next day to 104°. Five more injections; crisis twenty-four hours afterwards.

CASE XI.—Admitted fifth day. Developed parotitis. Six injections; recovery by lysis.

CASE XII.—Admitted seventh day of disease. Long history of alcoholism. Fits every day from beginning of illness. Five injections; improvement. Pneumonia spread to upper lobe of lung; death.

CASE XIII.—Admitted second day. Complicated with asthma; looked very ill and cyanosed. Six doses; crisis seventh day.

CASE XIV.—Admitted second day; 3 doses; crisis sixth day.

CASE XV.—Admitted third day; 4 doses; crisis seventh day.

CASE XVI.—Admitted third day; 3 doses; crisis seventh day.

Case XVII.—Admitted fifth day. Middle and lower lobes of right lung ; extensive pleurisy. Nine doses ; crisis on ninth day.

Case XVIII.—Admitted third day. Delirious and very irritable ; considered probable meningitis ; lumbar puncture negative. Eight doses ; crisis on eighth day.

Case XIX.—Admitted fourth day. Had been delirious for two days ; double basal pneumonia. Twenty-two injections ; crisis on tenth day.

Case XX.—Admitted second day. Double basal pneumonia. Twelve injections ; crisis on ninth day.

Case XXI.—Admitted first day of illness to surgical ward ; supposed appendicitis—had intense pain in right hypochondrium and right iliac region. Operation ; appendix healthy. Transferred to medical ward ; patient very ill, restless and irritable, and cyanosed ; all left lung affected and extensive pleurisy. Twelve injections ; quite quiet and comfortable after 3 doses ; crisis on twelfth day.

Case XXII.—Admitted fifth day. Delirious and very restless ; pulse dicrotic ; prune juice sputum ; double basal pneumonia. Six injections in twenty-four hours ; patient then quite quiet, and slept well ; crisis forty-eight hours afterwards.

Case XXIII.—Admitted third day. Very collapsed. Six injections in twenty-four hours ; crisis followed sixth injection.

Case XXIV.—Ill with bronchitis for fourteen days before admission. Pneumonia and pleurisy right lower lobe. Six injections ; crisis eighth day after admission.

Summary.—1. In quinine urea we have a definite treatment of pneumonia as opposed to the usual expectant method.

2. Cases of pneumonia with marked toxæmia are afforded a much better chance of recovery.

3. In all cases its administration makes the patient much more comfortable—allows of natural sleep, and the disease produces less strain on the heart and constitution.

CEREBRO-SPINAL FEVER.

By P. W. MACLAGAN, M.D.

III.—SYMPTOMATOLOGY.

BEFORE commencing a clinical description of cerebro-spinal fever it is desirable to consider the various factors which produce the signs and symptoms of the disease:—

1. The general toxæmia which is common to all infectious diseases.

2. The lesions of the central nervous system and its coverings.

3. The presence of certain products of degeneration of the myelin of the nerve fibres, namely, cholin and neurin.

All these factors are present in any one case, the varying picture produced depending on which predominates. One case may present the appearance of profound toxæmia and meningeal symptoms may be entirely absent; in another the symptoms of meningeal irritation may predominate and those due to toxæmia will be slight. All possible gradations between these two extremes may be found. The presence of cholin, or its derivative neurin, may be assumed, as they are products of the degeneration of myelin, which we have seen to be present, but their part in the picture is not easy to ascertain.

Incubation Period.—The determination of the exact length of the incubation period is a matter of great difficulty. The shortest time that may elapse between contact with a source of infection, *e.g.* a case or carrier, and the development of the disease is probably two to seven days. Opportunity to investigate this point occasionally arises when a soldier from an infected area arrives home on leave or is transferred to another district and infects some of those with whom he comes in contact.

Many observations have been made on this point by Netter, Foster and Gaskell, Flack, etc. The following is quoted by Flack:—"Sapper B. returned from France on 9th April 1916, and had been complaining of headache and pains in the back and legs while in the trenches a few days previously. There is no evidence that he had any meningitis. Two days after his arrival one of his children was taken ill and removed to hospital with symptoms of cerebro-spinal meningitis. Next day another child was taken ill and removed to an isolation hospital, where he died of the disease. The father was now isolated and found to be a carrier of type 2 meningococcus.

"A few days after removal the first child was discharged after what was termed an abortive attack of cerebro-spinal meningitis. He was fetched by his sister on the Thursday. Up till then the sister had been quite well. She did not subsequently see her father at close quarters, but on the following Sunday she was taken ill and died within twenty-four hours. A swab from the child having the abortive attack showed the presence of the type 2 meningococcus in the nasopharynx."

In this instance the incubation periods in the three cases appear to have been two, three, and four days. Many other similar instances of infection from cases and carriers are to be found in the literature.

Prodromal Symptoms.—In a few cases, a certain degree of malaise or evanescent headache has preceded the actual attack, One or two patients give a history of coryza lasting for a few days, and a considerable number have suffered from a slight post-nasal catarrh, such as has been previously described. On swabbing the nasopharynx to ascertain the presence of the meningococcus the swab is frequently tinged with blood, showing that a catarrhal condition is present. As a general rule, a patient will say that his general health was good up to the immediate onset of his illness.

Mode of Onset.—The initial symptoms are headache, shivering or rigor, and vomiting. These symptoms are common to most infectious diseases, and are due, in the first instance, to the condition of toxæmia present. The abrupt appearance of these symptoms, however, in a person apparently in normal health is characteristic of invasion by the meningococcus. The vomiting is almost invariable at this stage of the disease, but may not be repeated.

In most cases there is a period of shivering, which may develop into a definite rigor or may merely amount to a feeling of chilliness. In quite a few instances this latter may persist for a considerable time.

In infants, convulsions take the place of the rigor in adults. Associated with these sensations of cold there is a rise of temperature, probably in the region of 101° F. to 102° F. In a fair number of cases this temperature after the onset falls to normal, to rise again later.

The headache is intense. It may be diffused over the whole head, but it is most usually located in the occipital region. It is persistent, and may become so excruciating as to overcome the fortitude of the strongest man and cause him to cry out. In the

first instance the headache is toxæmic in origin, but as the case progresses, the cerebro-spinal fluid becomes increased in quantity, and the rise in intracranial pressure is accountable for this symptom. It may now be greatly relieved by lumbar puncture.

In a few cases the onset is even more sudden than that described above. A man, apparently well, may suddenly become unconscious either with or without an attack of vomiting. In these cases death may occur in a few hours. Signs of meningeal involvement appear within a few hours of the onset. This period is seldom as long as twenty-four hours, and in most cases is very much less. In one or two exceptional cases it is prolonged for two or three days, but eventually meningeal symptoms arise.

Symptoms and Signs during the Acute Stage.—The general appearance of the patient is fairly characteristic. His face is flushed or perhaps slightly cyanosed, his expression is strained and anxious, and he gives one the impression of being extremely ill. He lies on one side with his knees drawn up. This attitude is assumed in order to prevent pressure on the occiput and spine. The general appearance of the patient varies with the type of case, as we shall see later.

A characteristic gait has been described, somewhat resembling the forward walking of paralysis agitans, but very few patients are in a condition to walk.

The mental condition varies from approximately normal to absolute unconsciousness. In most instances the intellect is to a certain extent clouded, the patient is stupid and irritable, but can be roused, and will answer questions rationally. While a condition of coma usually supervenes some time before death occurs, it is not unknown for a patient to remain perfectly conscious to the end. Delirium, often paroxysmal, is very common. It varies from a mild muttering form to a wild maniacal. So marked has this symptom been in one or two cases that the patient has been placed under restraint, as a case of acute mania, before the real cause of his condition has been recognised. The delirium is usually more marked at night, but there is no great tendency for these patients to get out of bed, and, as a rule, they can easily be restrained. The mental condition is much influenced by the operation of lumbar puncture and the relief of intracranial pressure. Insomnia is frequently very depressing during the acute stages, and it may persist for some time into convalescence.

Headache is complained of in most cases all through the acute stages of the illness. It is more marked at night, and is relieved

by lumbar puncture. Practically all patients complain at some period of their illness of pains in the legs and back. These are described as cramp-like pains, and are chiefly located in the muscles. Pain at the back of the neck, of a similar nature, is also common. These pains are probably due to the involvement of the posterior nerve roots in the exudate surrounding the cord. Severe lumbo-sacral pain is common when the patient is first allowed to sit up, and may persist long into convalescence. Hyperæsthesia is extremely common, and is most marked along the line of the spine. It is frequently relieved by lumbar puncture. Intolerance to light and sound is very common, and Kerr frequently noticed an extraordinary sensitiveness to cold.

Fever.—The temperature is extremely variable during the course of the disease, and is considerably modified by lumbar puncture. Perhaps the most typical chart is one in which the temperature rises at the onset, falls nearly to normal, and then rises again to 101° F. or 102° F., and remains at this level, with morning remissions of ½ to 1 degree for five or six days, and then falls by lysis. Many cases show extremely irregular temperature charts, the temperature rising and falling without much change in the patient. A few cases run an almost afebrile course, and this may be one of considerable severity. Fulminant cases are often of this type throughout their short and fatal illness; in others, however, of an apparently similar type the temperature reaches hyperpyretic levels. In a few cases the temperature chart resembles that of a case of quotidian malaria, and this similarity has led to errors in diagnosis.

Almost invariably lumbar puncture causes a fall in the temperature, but in a few cases, for some obscure reason, a rise takes place. In cases which progress favourably the temperature falls to normal and remains so. In others, usually in those in which there is a degree of hydrocephalus, the temperature continues to swing for many days in a most irregular manner. A temperature which has been swinging for some time does not, as a rule, settle down at once. It may remain normal for a day or two, and then rise, to fall again. This may be repeated a few times, the swings becoming less in amplitude each time, until the level remains persistently normal. During convalescence occasional elevations of temperature are fairly common, but they do not seem to have any bearing on the progress of the case. In cases in which internal hydrocephalus becomes established the temperature remains normal, with occasional elevations lasting only a few hours.

For many days before death it may remain persistently subnormal.

Pulse.—In cases of increased intracranial pressure from any cause the pulse-rate is slowed. In cerebro-spinal fever, in addition to the rise in intracranial pressure, the degree of toxæmia must be taken into account. The one condition tends to slow the pulse, the other to increase its rate. In most infectious diseases the pulse-rate is increased, more or less in correspondence with the height of the temperature. In cerebro-spinal fever this correspondence is not maintained; the pulse-rate is noticeably slower than we would expect with the degree of fever present. With a temperature of 102° F. we will often find a pulse-rate of 80 to 90 to the minute, seldom more. Frequently it does not rise above 75 to 80 in the first week of the disease. If the case is a prolonged one, the pulse-rate will rise as time goes on, and may become very fast as death approaches. In fulminant cases the rate is increased from the first and the pulse becomes feeble and irregular. No pulse may be perceptible at the wrist for some considerable period before death in one or two of the most acute cases.

Blood-Pressure.—The blood-pressure in cerebro-spinal fever has been the subject of most minute and careful study by Sophian: He has made particular observations as to the relation between lumbar puncture and the intrathecal injection of serum, and the blood-pressure. He finds that the blood-pressure is markedly raised in correspondence with the rise in intracranial tension in the acute stages of the disease. Later it falls, and during convalescence is fairly low. My own observations are in complete agreement with these findings. The operation of lumbar puncture causes a fall in blood-pressure, and the intrathecal injection of serum a further, and it may be very serious, drop. This phenomenon is so well marked that Sophian graduates his dosage of serum by observations on the fall of blood-pressure. In my experience I have never noted a dangerous fall in blood-pressure from the gradual administration of serum intrathecally, even in considerably larger doses than those employed by Sophian.

The Respiration.—In an ordinary case of cerebro-spinal fever, where there are no respiratory complications, there is little change in either respiratory rate or rhythm. In those cases where there is a marked degree of toxæmia there is considerable respiratory embarrassment. The respirations become extremely rapid and shallow, and there is a varying degree of cyanosis. In the more

severe cases, and especially where the condition of internal hydrocephalus supervenes, there are great variations both in rate and rhythm.

Three chief variations are met with :—

1. *The Cheyne-Stokes Type.*—Here we have rhythmical alterations of the respiratory movements, with periods of apnœa. The respiratory periods are of the same length and are composed of the same number of respiratory movements, the amplitude of the movement gradually increasing to a maximum and then falling off again. The duration of the period of apnœa equals a half to three-quarters of the whole period. This type is only seen in grave cases with marked toxæmia, but it does not appear to have the invariably fatal significance that it has in abdominal conditions, for example.

2. *The Biot Type.*—Here the periods of apnœa occur at irregular intervals and vary in length. There is great variation in the rhythm and force of the individual movements, and there are frequent deep sighing respirations. These are the characteristic features of the type. This type was first described by Biot in 1878 as frequently occurring in cases of meningitis. Further investigations have shown that it is almost pathognomonic of this condition. Connor and Stillman studied the respiratory rhythm in 300 cases of various diseases in children, and were only able to find the Biot type in cases of meningitis. It appears most frequently in those cases with internal hydrocephalus.

3. *The Undulatory Type.*—In this type there is no period of apnœa, but regular wave-like variations in the depth and frequency of the respiratory movement. This type is seen in all grave cases, but is not of a great diagnostic value.

Eye Symptoms—Pupillary Changes.—Mydriasis is commonly present, and is said to be one of the earliest signs of meningitis. The pupils, however, are markedly contracted in one or two cases of cerebro-spinal fever, and they are frequently unequal in size. The light reflex may be lost, and is often very sluggish. In comatose patients the conjunctival reflex is usually lost.

Muscular Derangements.—Strabismus is present in quite a large number of cases. In my experience this has always been of the nature of an internal unilateral strabismus. Paralysis of the sixth nerve is easily understood when one remembers its long course through that part of the subarachnoid space in which the exudate is most abundant. In the great majority of cases this paralysis is only temporary. The occurrence of optic neuritis is very rare,

even in chronic cases—not nearly so common as in tubercular meningitis. In a series of thirty of my cases examined by an expert ophthalmoscopist one showed a certain degree of papillitis, and this was the only change noted. I have examined many acute, and practically all my chronic, cases with the ophthalmoscope, and in no case was there any change in the optic discs. A few patients complain of dimness of vision, but this is not accompanied by any obvious change. Cases of total blindness are common in early literature, and are still occasionally recorded, but this unfortunate sequel is not nearly so common as it used to be.

Reflexes—Superficial.—These are present in the milder cases, and are lost in the more severe and on the approach of death. The loss of the abdominal reflex is not nearly as constant as has been described. Except in fulminant cases it is always present early, and in mild cases it is often very brisk. The Babinski phenomenon is rarely present in adults, but may occasionally be elicited. In children under 2 years of age it is normal.

Tendon Reflexes.—In the earliest stages the tendon reflexes are exaggerated, and they may be elicited throughout the whole course of the disease in mild cases. In the more severe types they are abolished during the acute stages, to reappear in convalescence. In cases in which internal hydrocephalus develops, the tendon reflexes are all exaggerated. Ankle clonus is described as being occasionally present, but is very rare.

Vasomotor Changes.—Tache cérébrale is always present, but is not of much diagnostic importance.

Trophic Changes.—Patients suffering from cerebro-spinal fever are extremely liable to the occurrence of pressure sores, which are slow to heal and apt to spread rapidly if great care is not taken. One of the most striking features of the disease is the extraordinary wasting of the subcutaneous fat and of the muscles. This feature often appears early in the disease, and proceeds with great rapidity. Cases dying at the end of ten to fourteen days' illness often do not have a particle of subcutaneous fat in their bodies. Hydrocephalic cases are invariably extremely emaciated. This change occurs even when a fair amount of nourishment is being taken, and appears to be, at least in part, due to involvement of the trophic centres. Another explanation of this phenomenon may be suggested. Cholin is capable of acting as a co-enzyme of the fat-splitting ferment lipase. The presence of these two substances acting together might account for the excessive removal of fat.

I have not been able to obtain any experimental proof of this suggestion, but it might be worthy of further investigation.

Muscular Rigidities.—Stiffness of the neck is one of the earliest and most important signs of meningitis. It is absent only in those cases of profound toxæmia in which there is coma or complete muscular relaxation. In all other cases it is present to a greater or less extent. In severe cases the whole musculature of the neck and back is rigid, and on attempted flexion the spine feels as if ankylosed together. The lesser degrees of rigidity are less easy to appreciate and to distinguish from the stiffness due to rheumatism, etc., but it will be found that the stiffness due to rheumatism tends to become less during examination, whereas that due to meningitis becomes more marked. Much practice in normal as well as in abnormal conditions is required before the slighter degrees of this sign can be demonstrated with certainty.

Head retraction is a more marked condition of the same sign. It is much less common in adults than in infants, but is fairly common in the former. A condition of opisthotonus is common in children, but is rarely seen in adults. The cause of these signs is pressure on the nerve roots, due to distension of the subarachnoid space. The capacity of this space is less in a position of flexion of the spine, and greater in a position of extension, as can easily be demonstrated in the course of a lumbar puncture, flexion of the spine causing a greater flow of cerebro-spinal fluid. The lessened frequency of marked head retraction and of opisthotonus in adults is due to the fully ossified condition of the vertebræ allowing less freedom of movement in the direction of extension.

Kernig's Sign.—This sign was first described by Kernig of Petrograd, in 1882, as being a constant sign of meningitis. It was at first considered to be pathognomonic of this condition, but it has since been demonstrated in cases of meningism, due to various toxæmias, and in meningeal hæmorrhage. Kernig's sign appears early, and as it is more easily appreciated than the slighter degree of neck rigidity, it is perhaps the earliest sign of meningitis to be elicited. It is present in all cases of cerebro-spinal fever, except those cases of intense toxæmia in which there is complete loss of muscular tone. The sign is supposed to be caused by the stimulus of the tension placed upon the inflamed nerve roots during its demonstration.

Brudzinski's Signs.—In 1908 Brudzinski described two leg

signs and a neck sign commonly seen in meningitis. *Leg Signs.*—With the patient lying on his back, if one leg is raised from the bed and flexed at the knee, the other leg is either flexed—identical contralateral sign — or extended — reciprocal contralateral sign. Of these two signs, the identical contralateral sign is commonest in adults, though the reciprocal sign is fairly frequently seen. The cause of these signs is somewhat difficult to understand. Brudzinski stated that the identical sign was due to the fact that the flexor muscles of the body predominate, and that in the reciprocal sign there is a reversion to an antenatal condition. *Neck Sign.*—With the patient lying on his back, forcible attempts to flex the head upon the chest causes flexion of the legs at the knee. This sign is present or absent in the same class of case as Kernig's sign, and is probably due to the same cause.

Guillain's Sign.—With the patient lying on his back, if the observer pinches the quadriceps extensor muscle of one leg between the finger and thumb, the opposite leg is drawn up on the abdomen. This sign can certainly be elicited in a considerable number of cases of cerebro-spinal fever, but I am not yet certain how far it is confined to this disease.

Macewen's Sign.—Percussion of the skull in the region of the lateral ventricles gives a resonant note if the cerebro-spinal fluid which they contain is under pressure. This sign is somewhat difficult to demonstrate in adults, and it is useless in infants before the closure of the fontanelles.

Gastro-intestinal Symptoms.—The vomiting of the invasive stage has already been described. Vomiting at a later stage usually indicates the establishment of a condition of internal hydrocephalus. When this condition is established, irregular vomiting is of frequent occurrence; it is not preceded by nausea, and may be projectile in type. Incontinence of fæces is the rule in fulminant and in most severe cases; in others, and in all convalescents, constipation is the rule. This is very obstinate and requires careful attention. Occasionally there is a marked diarrhœa in the early stages. Diffuse abdominal pain is fairly common. I can come to no definite opinion as to its causation.

Urinary Symptoms.—Retention of urine has been described as an early symptom of great importance. This has not been the case in my series of cases. It is only present occasionally, and speedily yields to treatment. Incontinence of urine is present with incontinence of fæces in many severe cases. In cases with incontinence, care must be taken that it is not merely the over-

flow from a full bladder. A transitory albuminuria of febrile origin is very common, but always clears up. Hæmaturia may be noted in a few of the cases with profuse purpuric rashes, and very occasionally in others, in which case the condition is temporary and leaves little trace in the kidney. A transitory glycosuria has been described, but it is rather doubtful if the reducing substance present is really glucose. If adrenalin is administered at any period, a reducing substance will appear in the urine, and may lead to some confusion. In all cases there is a great increase in the amount of urea excreted. The urine is frequently loaded with urates during the acute stage.

Blood Changes.—The essential feature in the blood picture in cerebro-spinal fever is the marked leucocytosis which is invariably present. This varies from about 20,000 per c.mm. in a mild case to 40-50,000 in the most acute. The differential count shows that this leucocytosis is largely polymorphonuclear in character, and that there is a great increase in the number of large mononuclear cells; also the lymphocytes are comparatively diminished, while the eosinophiles are almost entirely absent. As in other infectious diseases with a considerable leucocytosis, myelocytes and other immature forms of leucocyte are occasionally seen.

A few typical counts will illustrate most of these points:—

Total Count.	Polymorphs (Large). Per cent.	Mononuclears. Per cent.	Lymphocytes. Per cent.	Eosinophiles. Per cent.
1. 23,400	80	9	11	0
2. 26,870	74	8	18	0
3. ...	74	7	19	0
4. Mild case	66	15	17	1
5. ...	83	7	9	0

Polynuclear Count.—The method employed is that described by W. E. Cooke. It is said to be a measure of the degree of toxæmia present, and to indicate the amount of reaction on the part of the polymorphonuclear cells.

The following are a few typical counts:—

	1.	2.	3.	4.	5.	
1. . . .	62	32	5	1	0	Fatal case.
	94		6			
2. . . .	53	30	14	3	0	,, ,,
	83		17			

3. . .	40	45	14	1	0	Recovery.
	85		15			
4. . .	45	38	14	3	0	,,
	83		17			
5. . .	44	44	10	2	0	,,
	88		12			

It will be noted that in the two fatal cases quoted above, the number of cells in class 1 is much higher than in those which recovered.

The count is of considerable value in prognosis, and probably gives a certain amount of guidance in treatment. As the case improves, the count tends to resume the normal. In a case in which it remains left-handed, any improvement is probably only apparent. The above differential and polynuclear counts are examples taken from some hundreds which we have done during the present epidemic.

Rashes.—The name "Spotted Fever" was applied to this disease during the earlier epidemics in America and elsewhere, on account of the frequency with which a profuse hæmorrhagic eruption was noted. Further observations of this disease have shown that the frequency of this symptom has been over-estimated, and that the specific eruption is not hæmorrhagic in character. In the majority of cases no rash can be observed. That which appears most frequently, and which is most characteristic, is a diffuse macular erythema. This rash is most marked on the trunk, and lasts only for a short time, but leaves a peculiar subcuticular mottling, which persists for several days. A similar morbilliform eruption is sometimes seen on the limbs in conjunction with the purpuric rash of the fulminant type. Another erythematous eruption is sometimes seen over the points of pressure, notably over the buttocks and scapulæ. This is similar in type, and leaves a group of small petechial spots, which fade in a few days.

In perhaps 10 to 12 per cent. of cases the rash is hæmorrhagic in character. The type of case in which this appears is the fulminating case, with marked toxæmia, and in which the meningococcus can usually be recovered from the blood. In the most hyperacute cases the whole body is covered with large purpuric patches, which may be several inches square.

In rather less severe cases the rash is petechial in character, the petechiæ varying in size and number with the severity of the general toxæmia.

A herpetic eruption, appearing about the third day, is extremely common. By far the most common site is round the mouth and nose, but it is not necessarily limited to this situation. Sophian describes a case with herpes of the palate, and typical herpes zoster has been noted, also herpetic eruptions following the distribution of various superficial nerves.

When serum is used in the treatment, various serum rashes may appear about ten days after the first dose. These are usually urticarial in character, but may be morbilliform or scarlatiniform. These must be distinguished from rashes due to the disease itself.

Relapses.—In a certain number of cases we have a reappearance of all the signs and symptoms of the disease after apparent recovery. The frequency with which this occurs varies very greatly in different epidemics, but in comparing various figures given we must clearly state the point at which we regard convalescence to be established. For practical purposes we may take it that a patient is convalescent when his temperature has remained normal, when he has not complained of headache for a few days, and when there is no longer any stiffness of the neck or Kernig's sign. If this definition is accepted, relapses in cerebro-spinal fever are comparatively rare, and only occur in about 2 per cent. of cases. All cases which run a protracted course show altering periods of slighter and more marked symptoms, and these exacerbations may easily be mistaken for relapses if the persistence of one or other of the cardinal signs is not observed. The onset, course, and symptoms of a relapse are similar to those of the original attack. The case may end fatally, though, as a rule, its course tends to be more favourable.

As to the cause of a relapse, there are two possibilities to be considered: Firstly, a reinfection of the meninges from a persisting local infection of the nasopharynx; and secondly, the lighting up of some remaining focus in the meninges or elsewhere. Probably the second explanation is the correct one, as I have seen relapses in patients whose nasopharynx has been found to be free from the meningococcus.

Complications.—In discussing the complications which may arise in the course of a case of cerebro-spinal fever we must again remember the great variations seen in different epidemics. Phenomena which are almost constant symptoms of one epidemic

may be extremely rare in another. For example, pneumonia has been present so commonly in some epidemics, and even during a period of my present series, as to lead one to accept it as a regular feature of the disease. In others it appears to have been a relatively rare complication. Again, retention of urine has been so constant during one series of cases of the epidemic of 1915 that it has been described as an early symptom of great diagnostic importance. In my series it has been so rare that it might be described as a complication.

We may divide the complications of cerebro-spinal fever into two classes: (1) Complications resulting from the general toxæmia; (2) complications resulting from lesions of the central nervous system and its covering membranes. The first class is more commonly seen in the first few days of illness, and is more common in those cases with a severe general infection. The second may follow what are apparently quite mild cases, as well as the more severe.

Arthritis.—This is one of the commonest complications of cerebro-spinal fever, occurring in from 10 to 15 per cent. of all cases. It usually commences during the first five or six days of the disease, and usually affects the larger joints. As the severity of the general symptoms diminishes, it is quite common for a patient to complain of pain on moving one or more of the larger joints—most commonly the knee or shoulder. As long as the joint is kept at rest there is little complaint, but the least movement causes severe pain. On examination the joint is found to be swollen and tender, but does not exhibit the redness seen in most cases of arthritis. As a rule, the joint condition clears up in a few days and leaves no trace. In a few cases the condition becomes more chronic, and in a very few suppuration occurs. In the chronic cases the pain on movement persists for several days, and occasionally for weeks. Sophian describes two cases in which the condition persisted for as long as four months.

In those cases in which suppuration occurs the joint becomes distended with fluid, and the fluid withdrawn through an exploring needle is turbid, containing mostly polymorph cells and a few intracellular meningococci. The extraordinary fact about these cases is the fact that, after simple aspiration of the fluid, the condition completely subsides, and no permanent disability is to be noted.

The lesion found in all cases of joint infection is a synovitis. In cases of serum sickness joint pains are a common feature.

These must be distinguished from those due to the disease itself.

Respiratory System.—Severe catarrh of the upper respiratory passages, with profuse purulent discharge, is occasionally met with. The slighter degrees of coryza and nasopharyngitis have already been mentioned.

Lobar Pneumonia.—Consolidation of one or both lower lobes may frequently be seen early in the disease in some epidemics. It occurs in severe cases, and adds greatly to the gravity of the prognosis. It is to be distinguished from the hypostatic congestion occurring in enfeebled chronic cases, and from septic pneumonia due to inhalation of vomited matter during unconsciousness. Associated with pneumonia, a certain amount of pleuritic effusion or adhesions will often be noted.

Cardiovascular System.—Meningococcic endocarditis has been described by several writers. In two instances suppurative pericarditis was noted post mortem during my present series, both in fulminant cases. The cells of the exudate were polymorph leucocytes, with intracellular meningococci.

Phlebitis may occur, apparently confined to the veins of the leg, giving rise to the usual signs and symptoms of this condition, and running the usual course.

Other Complications.—Pyelitis of a benign variety, and leaving no permanent lesion, is described by Sophian as being of rather frequent occurrence. I have not been able to demonstrate this point during this epidemic, either clinically or post mortem. Once or twice, in severe cases with a profuse hæmorrhagic rash, I have noticed marked hæmaturia. This has invariably cleared up in a few days, if the patient has lived long enough, and post mortem little change can be found in the kidneys. Acute nephritis, with blood and casts in the urine, occasionally is met with in acute cases. It runs an extremely favourable course, and does not materially affect the prognosis.

Purulent conjunctivitis is frequently present. The pus consists of polymorph leucocytes, with intra- and extra-cellular meningococci. Pan-ophthalmitis, with complete destruction of the contents of the orbit, has been described.

Catarrhal otitis media occurs with considerable frequency. Goeppert noted it in as many as 75 per cent. of his cases. It is usually very mild and easily overlooked, and seldom leads to perforation of the tympanum or infection of the mastoid cells. Deafness is a fairly common complication, and may be temporary

or permanent. It usually appears in the first few days, and in the great majority of cases gradually clears up; in others it may remain permanent. It is stated that temporary deafness is due to œdema of the lining membrane of the auditory canal, and that in those cases which are left permanently deaf the auditory nerve has been destroyed by the involvement of its fibres in the inflammatory process. Occasionally the inflammation spreads to the internal ear, involving the semicircular canals and causing loss of the power of equilibration. In connection with these complications due to aural diseases the statistics of some of the earlier epidemics are interesting. Moos found that out of 64 convalescents from cerebro-spinal fever 38 were deaf-mutes, 20 absolutely deaf, 5 partially deaf, 1 not deaf at all, and 32 with a staggering gait. Again, Voltolini described a disease, the symptoms of which were deafness, deaf-mutism, and staggering gait, coming on after a sharp feverish attack accompanied by severe cerebral symptoms. Voltolini ascribed this condition to primary inflammation of the labyrinth, but it might quite well be due to meningitis spreading to the ear.

Optic atrophy is rare in this form of meningitis, and only occurs in prolonged cases where there is marked internal hydrocephalus.

2. *Complications Due to Lesions of the Central Nervous System —Headache.*—One or two cases have complained of paroxysmal attacks of headache for some months after recovery.

Mental Changes.—Irritability of temper and other changes in disposition occasionally occur, and several patients appear to be mentally dull after recovery. It is, however, difficult to estimate the degree of change due to the disease.

Paralysis.—Complete paraplegia has occurred in three cases in a series of over 400. It occurs during the acute stage of the disease. In one case which proved fatal it was found to be due to an extensive hæmorrhage over the Rolandic area. In the other two, which recovered, it was evidently due to the pressure of inflammatory products. This has been found to be the cause in a case reported by Foster and Gaskell. In these cases paralysis appeared on the fourth or fifth day of the disease, complete flaccid paralysis of one side, with absence of reflexes and no Babinski's sign, being present. One or two days later the tendon reflexes could be elicited, and after ten days or a fortnight the paralysis began to clear up, power first returning to the muscles of the leg, then to the arm, and lastly to the face. In both of my cases it almost entirely cleared up in two months.

Very occasionally monoplegias may be noted, either the arm or the leg being affected. These also tend to clear up ultimately. In one very old-standing case, with marked internal hydrocephalus, there was complete paraplegia, and complete loss of sensation of both limbs and lower part of the trunk. Finally, a condition similar to Charcot's joint developed in both knee-joints. Post mortem the meninges were found to be adherent to the cord in the dorsal region, and on section the nervous tissue of the cord was found to be almost completely destroyed. In one or two cases I have noticed a condition similar to progressive muscular atrophy, affecting the smaller muscles of the hand and spreading to the forearm. The condition improved as convalescence became established, and eventually entirely recovered.

Internal Hydrocephalus.—We have already seen the part played by this condition in the production of the symptoms of the acute stage. At a later stage of the illness a condition of chronic internal hydrocephalus is of even greater importance, and is the cause of a very large part of the mortality amongst those cases which survive the acute stage.

In considering the production of internal hydrocephalus we must realise that the factors giving rise to this condition vary in the different stages of the disease. Accumulation of fluid in the cerebral ventricles may be due to increased production, to diminished absorption, or to a combination of these two factors. We have seen that the chief source of the cerebro-spinal fluid is from a process of infiltration through the choroid gland of the lateral ventricles. We have also seen that one of the first results of an infection by the meningococcus is a toxic condition of these glands. This allows the passage of substances normally filtered out or only allowed to pass through in infinitesimal quantities, and it is only reasonable to suppose that with these there is an increased quantity of water. Again, we have noted that during the acute stage of the fever the cerebral sinuses are acutely congested, and that a condition of venous stasis is present. This must interfere with the absorption of fluid from the subarachnoid space to a marked degree. Therefore we see that both increased production and diminished absorption are present to produce the internal hydrocephalus of the acute stage. There is, at this period, no mechanical hindrance to the free flow of fluid from the ventricular system to the subarachnoid space, and if our treatment of the disease be successful in combating the infection and in relieving the increased pressure, the choroid glands and the

cerebral sinuses will resume their functions. In a certain proportion of cases the process of recovery of these functions requires a considerable period, and though we may relieve the pressure of fluid by lumbar puncture, it rapidly recurs. In these cases the increased pressure must not be allowed to remain, but must be constantly relieved, until such time as it does not recur.

So far we have been observing cases of acute or subacute hydrocephalus; we must now discuss the changes found in a chronic case. These changes will be found to occur in cases in which there has been an abundant accumulation of purulent exudate at the base of the brain, in the cisterna magna, and in the ventricles themselves. Post mortem, this exudate will be found to be partly organised and partly or completely occluding the foramen of Majendie and Lushka, or even the foramen of Munro. In this way the circulation of the cerebro-spinal fluid from ventricles to subarachnoid space is interfered with to a greater or less degree, and the absorption of the fluid by the cerebral sinuses which are in connection with the subarachnoid space is prevented. The increased pressure in the ventricles now, of course, cannot be relieved by lumbar puncture, and the prognosis in these cases is extremely grave. The early recognition of the persistence of internal hydrocephalus in a case of cerebro-spinal fever is of the utmost importance. We may note that many of the acute symptoms are markedly ameliorated. The patient appears less toxic, he may feel much better for a few days, he takes food well, and his temperature declines. However, instead of continuing to improve, his headache returns and may be paroxysmal, vomiting reappears, the temperature becomes very irregular, neck rigidity is marked, and Macewen's sign may be made out.

If the condition is not relieved, intense headache, extreme emaciation and volitional tremors make their appearance, and the intellect becomes clouded. It is at this period that the changes in respiratory rhythm are most marked and can be most easily observed. The temperature eventually falls to normal or subnormal, there is incontinence of urine and fæces, and bedsores appear. The pupils are dilated, the nystagmus is frequently present. The tendon reflexes are exaggerated, ankle clonus and Babinski's sign are occasionally present. Finally, coma sets in, the pulse becomes rapid, irregular and feeble, and frequently just before death the temperature becomes hyperpyretic; in other cases it remains persistently subnormal. When this state of affairs has

been established, lumbar puncture yields only a small quantity of almost clear fluid under little pressure. When this is found to be the case, we may assume that there is a mechanical obstruction at the base of the brain, and the prognosis becomes almost hopeless.

Death is due to pressure on the vital centres in the medulla. The meningococcus can no longer be isolated from the cerebro-spinal fluid, and there are few signs of acute infection. At this period lumbar puncture must only be performed after careful consideration, as in several instances where it has been done, sudden respiratory failure has occurred a few minutes later. The heart continues to beat, and only fails later when efforts to re-establish the respiratory rhythm prove unavailing. This accident is evidently due to disturbance of pressure in the fourth ventricle. I have also noticed the occurrence of repeated epileptiform attacks after the condition of internal hydrocephalus has been established for some time.

Diagnosis.

The diagnosis of cerebro-spinal fever may be divided into two sections—(1) Clinical; and (2) laboratory. In very few cases can one say definitely that a given case of meningitis is caused by the meningococcus. As a rule, one can only ascertain that the case is one of meningitis, and then obtain material from which one is able to form a positive opinion in the laboratory.

1. Any case of suppurative meningitis may present precisely the same signs and symptoms, though an obvious focus of infection, *e.g.* middle-ear suppuration, may help one to arrive at the nature of the meningeal infection. During an epidemic the problem is comparatively simple, but at other times the diagnosis must be fraught with considerable difficulty. In studying a patient suspected of suffering from cerebro-spinal fever one would consider the mode of onset, and carefully look for such signs as neck rigidity, Kernig's and Brudzinski's signs, hyperæsthesia, tache cérébrale, dilatation of the pupils, and petechial or purpuric rash. The comparative rarity of the rash must be remembered, but when it is present along with the other signs of meningitis, the diagnosis of cerebro-spinal fever is almost final on clinical grounds alone.

2. *Laboratory—Bacteriology.*—We have seen that the meningococcus can be found almost invariably in the nasopharynx and in the cerebro-spinal fluid, sometimes in the blood, and perhaps, occasionally, in the urine in cases of cerebro-spinal fever.

The isolation of the meningococcus from either cerebro-spinal fluid or blood is absolute proof of the nature of the infection. Its presence in the nasopharynx is of less value, as we have seen that many healthy persons may carry the organism in this region. Taken in conjunction, however, with the signs and symptoms of meningitis, it is extremely suggestive. We have also noted that in old-standing cases it is often extremely difficult to determine the presence of the meningococcus in the cerebro-spinal fluid, and it is almost certainly impossible to isolate it from the nasopharynx or the blood. In these cases we have to depend more largely on the chemical and cytological changes. The blood-serum of the patient may show the presence of specific agglutinins for the meningococcus. This is evidence of a meningococcal infection, as normal blood has not this property. This reaction is very erratic as to the date of its appearance, if, indeed, it ever appears at all, and little reliance can be placed upon it. A negative result does not exclude cerebro-spinal fever. The physical, chemical, and cytological changes in the cerebro-spinal fluid have already been fully discussed, and it has been seen that their study in cases of meningitis from which no specific organism can be isolated may be of the utmost diagnostic value.

In the acute stage we will find that the fluid is turbid, owing to a polymorphonuclear exudate, the protein content is much increased and the sugar is absent, but in these cases the presence of the meningococcus usually can be demonstrated and the diagnosis confirmed. In the later stages the fluid is clearer and frequently yellow in colour, and the cells present are largely lymphocytes. There is still great increase in the protein content, but the presence of sugar can now be frequently demonstrated.

The appearances presented closely approximate to those seen in tubercular meningitis, and the clinical history of the case must be carefully considered in order to separate these two conditions.

Mistaken diagnosis may be due to—(1) Absence of one or more of the cardinal signs. In toxæmic cases there may be complete absence of muscular rigidity. (2) Prominence of some symptom or symptoms pointing to another disease—(*a*) cyanosis and rapid respiratory rate, suggesting acute lobar pneumonia; (*b*) acute cardiac dilatation. (3) Other diseases presenting a clinical picture, with several features belonging to cerebro-spinal fever.

Differential Diagnosis.

A large number of very varying diseases may be, for one reason or another, confused with cerebro-spinal fever. These may roughly be divided into three classes—(1) Other infectious diseases. (2) Various lesions of the central nervous system and its appendages. (3) Any case of sudden coma, for which no cause is obvious.

1. During the invasive stage many infectious diseases, including cerebro-spinal fever, present similar symptoms. Fever, headache, and vomiting are early symptoms of almost every acute infection, and until characteristic signs and symptoms appear no diagnosis is possible. The commonest infectious diseases to be confused with cerebro-spinal fever are pneumonia, typhoid and typhus fevers, influenza, acute rheumatism, and, in some epidemics, acute anterior poliomyelitis.

Pneumonia.—In common with cerebro-spinal fever the onset is sudden, with fever, headache, and vomiting; frequently there are present delirium, restlessness, and some degree of cyanosis, with embarrassed respiration. In both diseases herpes labialis is common. As a rule, definite signs of meningitis, neck rigidity, Kernig's sign, etc., are absent, but we must remember that, on the one hand, pneumonia, especially apical, may show signs of meningeal irritation, and, on the other, that lobar pneumonia is a not infrequent early complication of cerebro-spinal fever. If there is the slightest suspicion as to the presence of meningitis, the cerebro-spinal fluid must be at once examined.

Typhoid Fever.—This disease can usually be distinguished by its insidious mode of onset. Occasionally, however, the onset may be quite acute, with headache, delirium, and restlessness. Vomiting is not common in typhoid, and the spleen rapidly becomes enlarged. The Widal reaction is present in typhoid, but as all soldiers are inoculated with typhoid vaccine, this reaction loses its value in military epidemics. Ehrlich's diazo reaction is commonly present in typhoid, and the absence of a polynuclear leucocytosis is strongly against cerebro-spinal fever.

Typhus Fever.—This disease is exceedingly rare in this country but is extremely common in several countries in which our troops are at present operating, hence the importance at the present time of differentiating it from cerebro-spinal fever. The appearances presented by acute cases of these two diseases are so alike that much confusion has arisen in the past. Sudden onset,

muscular rigidities, purpuric rashes are found in both diseases, and in both the patient is extremely ill. The onset of the delirium and the appearance of the rash occur later in typhus, and the temperature curve is more regular. In the early stages of typhus the pupils are contracted, in meningitis they are commonly dilated; with typhus there is commonly a distinct and characteristic odour. Ehrlich's diazo reaction may be expected to appear in typhus.

Influenza.—The onset is again similar, with headache, fever, and vomiting, soreness of the back and limbs, and nervous symptoms may be prominent. As a rule the special signs of meningitis are absent, and there is no polynuclear leucocytosis.

Muscular Rheumatism may give rise to trouble in diagnosis. If the neck, back, or leg muscles are affected, neck rigidity or Kernig's sign may be simulated. The stiffness due to rheumatism becomes less during examination, but that due to cerebro-spinal fever becomes more marked. As a rule, there should not be much difficulty in arriving at a correct diagnosis.

Acute Anterior Poliomyelitis.—In the meningeal form of the disease, in which paralyses appear later, there may be considerable difficulty. The onset is sudden, with headache and vomiting, and there may be convulsions and muscular rigidities. Usually, however, there is no delirium or loss of consciousness, and paralysis of a definite group or groups of muscles will appear and remain permanent to a much greater extent than in cerebro-spinal fever. In poliomyelitis the cerebro-spinal fluid is clear and under moderate pressure, the fibrin and globulin content is increased, but there is no increase in the polynuclear cells.

Meningism.—This name was given by Dupré to a symptom-complex occurring in various infections. The signs and symptoms are those of meningitis, but these rapidly improve as the infective condition clears up. In cases which end fatally, death is due to the causative condition. Originally, meningism was chiefly described in connection with pneumonia, but more recently it has been recognised as occurring with various other infections. I have seen well-marked cases of meningism in cases of erysipelas, after typhoid inoculation, and after vaccination where there is marked secondary infection of the pustules and considerable general toxæmia. Frequently, along with fever and headache in these conditions, there has been neck rigidity, Kernig's and Brudzinski's signs, tache cérébrale, etc. On the other hand, there is a lack of the anxious pained expression of cerebro-spinal

fever, and an absence of mental symptoms. In these cases the cerebro-spinal fluid is under considerable pressure, but there is no increase in the albumin or cellular content, and the fluid is sterile. Post mortem, a moderate amount of œdema and sometimes a little opacity of the meninges has been described. The differentiation from cerebro-spinal fever depends on recognising the source of infection, and on the negative findings in the cerebro-spinal fluid.

2. *Tuberculous Meningitis.*—A family history of tuberculosis and the discovery of other tuberculous foci are of great importance. The onset is gradual and insidious. The severity of the headache and the frequency of the vomiting increase slowly, and the patient is mentally indifferent and stuporose, in contrast with the anxiety and delirium of cerebro-spinal fever. Herpes is rare in tuberculous meningitis and there are no other skin eruptions.

The cell content of the cerebro-spinal fluid is lymphocytic in character. I have seen during the past two years several cases of tuberculous meningitis in which the onset was acute and the diagnosis from cerebro-spinal fever difficult, but in these cases the meningitis was part of an extremely acute general miliary tuberculosis. The cerebro-spinal fluid contained considerable numbers of polynuclear leucocytes, but was sterile.

Pneumococcal Meningitis.—This condition is usually secondary to lobar pneumonia, but in view of the frequency with which pneumonia complicates cerebro-spinal fever, too much weight must not be attached to the lung condition. It is practically impossible to separate these two forms of meningitis clinically, and the diagnosis must be made from the bacteriological examination of the cerebro-spinal fluid.

Septic Meningitis.—In this case the existence of a septic focus will be discoverable. Middle-ear disease, with lateral sinus thrombosis, and perhaps cerebral abscess, is probably the commonest cause, but meningitis may occur during any septicæmia, from septic wounds, etc. The causative organism can be recovered from the cerebro-spinal fluid. Meningitis may occur during the course of various infectious diseases—typhoid, mumps, scarlet fever, etc.—but in these cases the existence of the primary disease gives the clue to the diagnosis.

Serous Meningitis.—This has been recognised by French writers for some time under the name "état meningitique." The patient presents all the signs and symptoms of meningitis.

The cerebro-spinal fluid is under considerable pressure, contains an excess of lymphocytes, and is sterile. This picture suggests a tuberculous origin, but as these cases invariably recover, and, as a rule, no tuberculous focus can be discovered, it must be admitted that their etiology is uncertain.

Meningeal Hæmorrhage.—This condition gives rise to signs of meningeal irritation, and so may cause trouble in diagnosis. The temperature is normal and pulse slow, and there are no cutaneous eruptions and seldom any delirium. The cerebro-spinal fluid is sterile and shows the presence of red blood corpuscles as well as leucocytes.

Cerebral Tumour with Intraventricular Hæmorrhage.—This was a case with a history of intense headache and vomiting, said to be of only one week's duration. On admission to hospital the patient was conscious, but rapidly became comatose, with laboured respiration, and died in a few minutes. The medical officer in charge of the case was strongly suspicious of cerebro-spinal fever. Examination of the cerebro-spinal fluid showed great increase of albumin and fibrin content, but no increase in the number of cells. Post mortem, a comparatively small tumour was found in the occipital lobe, with extensive hæmorrhage into the lateral ventricles.

3. During an epidemic, almost any illness associated with sudden loss of consciousness may be confused with cerebro-spinal fever. I have had admitted to my wards as fulminant cases of cerebro-spinal fever patients suffering from uræmia, in any stage of pneumonia, with post-epileptic coma, with heat-stroke, etc., etc. Lack of signs of meningitis and a careful clinical examination will usually establish the correct diagnosis. In any case where cerebro-spinal fever is suspected, lumbar puncture ought to be performed and the cerebro-spinal fluid examined. The operation is simple and can do no harm if ordinary precautions be taken, and in about 90 per cent. of cases of cerebro-spinal fever the diagnosis is at once confirmed.

(*To be continued.*)

THE TRAINING OF THE STUDENT OF MEDICINE:

AN INQUIRY CONDUCTED UNDER THE AUSPICES OF THE EDINBURGH PATHOLOGICAL CLUB.

VIII.—THE RELATION OF PHYSIOLOGY TO MEDICINE.

By J. S. HALDANE, M.D., F.R.S., Fellow of New College, Oxford.

IN spite of the great and striking development of physiology, and of the teaching of it, particularly on the practical side, there is a considerable, and in some respects growing, want of contact between physiology and practical medicine and surgery. As Professor Frederic Lea of Columbia University put it in a recent paper (*Journ. Amer. Med. Assoc.*, vol. lxvi. p. 640): "During their first or second year, or in both, the students receive their instruction in physiology. Most of them follow the course willingly because they have faith in the wisdom of the men who have planned the course, and faith that in some way not now clearly comprehended their training in it will be useful to them later. Nevertheless, too many students question the good judgment that imposes on them a difficult topic, the relation of which to the treatment of sick persons they do not understand. By the end of their second year they have completed their work in physiology, and lay the subject aside with a feeling of relief as they turn to the more congenial occupations of their two clinical years. Now they acquire a new vocabulary for which all along they have been longing. . . . With the passing of the physiologic words go also their meanings, and throughout the rest of the school career, and too often the rest of professional life, physiology is merely a scientific curiosity."

I wish to make some suggestions as to the causes of, and remedy for, the defects in living contact of physiology and the other immediately preparatory branches of medical study with practical medicine and surgery. I do not think that the causes lie so much on the surface as might at first be supposed. We have, I think, to dig rather deep to discover them, and to dig into a controversial subject. Hence I can hardly look for general assent to my conclusions. I hope, nevertheless, that they may at least give rise to a fruitful discussion.

The aim which medicine and surgery have constantly before them is to help in restoring health and preventing ill-health. Now let us first try to see from actual examples how medical and surgical interference can contribute in this direction. Though I have been outside ordinary medical practice ever since I was house-physician at the Edinburgh Royal Infirmary, my work has kept me in contact with many problems of preventive medicine; and recently the war has

brought me, like most other physiologists, back to ordinary problems of practical medicine. I will therefore take as examples one or two medical problems with which I have recently been in contact.

The first of these relates to the treatment of the acute stages of poisoning by ordinary lung-irritant gases, such as chlorine, phosgene, or trichlor-methyl-chloroformate. Some hours after a serious exposure to one of these gases the soldier begins to present very dangerous symptoms. The colour of the lips and face becomes either blue or leaden coloured: the pulse is rapid, and may be feeble and irregular: the breathing is increased, and a watery sputum is coughed up. At the same time the senses become dulled, and coma may supervene.

What is the meaning of this symptom-complex? Let us begin with the colour of the lips and skin. Evidently the blood in them has no longer its ordinary scarlet colour. This might be due to decomposition of the hæmoglobin by the poisonous gas, with formation of methæmoglobin or other decomposition products. But we can negative this theory very quickly by taking a drop of the blood, diluting it with water, saturating with carbon monoxide or coal-gas, and comparing the tint of the solution with that of normal blood similarly treated. The hæmoglobin shows no trace of decomposition; and if it had occurred, the colour of the lips would have changed immediately after the exposure to the gas, and not many hours later. The colour of the lips is therefore due to the presence of reduced hæmoglobin, as in any ordinary true cyanosis.

This cyanosis might be due either to great slowing of the circulation, or to deficient oxygenation of the blood in the lungs. There is, however, no sign of the cold skin and other evidences of great slowing of circulation; and in many cases the blood-pressure is still high, along with great cyanosis. It is evident, therefore, that the main cause of the cyanosis is deficient oxygenation in the lungs, and this in spite of vigorous and rapid breathing, which is evidently not obstructed by contraction of bronchi. The cause of this deficient oxygenation is made evident by post-mortem examination of similar fatal cases, as well as by the character of the sputum. The lung alveoli contain large quantities of albuminous liquid, and the alveolar epithelium is swollen and proliferating. The diagnosis is completed by the observation that on the administration of oxygen the cyanosis clears up and the circulatory and other symptoms improve. By administering oxygen we largely increase the percentage of oxygen in the lung alveoli, and thereby increase in still larger proportion the diffusion pressure of oxygen into the blood. Under normal conditions the partial pressure of oxygen is about 6 per cent. of an atmosphere in human venous blood, and 13 per cent. in the alveolar air, the difference being therefore 7 per cent. With the presence of liquid and swelling of the alveolar epithelium the pressure difference present is not sufficient to drive

enough oxygen through to oxygenate the blood at all completely. But we can increase the normal pressure difference as much as ten or twelve times by giving oxygen, so that the oxygen goes in far faster; and usually a quite moderate increase in the oxygen percentage of the air suffices to remove the cyanosis. The increase in the breathing multiplies by several times the pressure difference which enables CO_2 to pass out, so that escape of CO_2 is already provided for.

What, now, are the effects of the want of oxygen indicated by the cyanosis? We can observe some of these effects in mountain sickness, where the want of oxygen, to which, without the smallest shadow of doubt, mountain sickness is due, is produced by deficiency in the oxygen pressure of the air. In this case the want of oxygen is slight, but the nausea, headache, and extreme depression which result after a few hours' exposure to the rarefied air are formidable enough symptoms. Similar symptoms result from slight CO poisoning. With more serious want of oxygen, as in severe and prolonged exposure to CO, or to air very deficient in oxygen, the effects are far more formidable. There is very serious damage to the central nervous system, and both capillary hæmorrhages and large hæmorrhages may occur in the brain. The heart becomes weak and dilated, with the mitral valve probably incompetent. The kidneys and other organs may also be injured; and recovery, if it occurs, is slow and gradual. Evidently, therefore, any serious want of oxygen, if allowed to go on, is a source of great danger, unless the patient has been gradually acclimatised to it, as in some cardiac cases. The breathing, though it is increased, gives no definite warning of this danger. There is, for instance, no marked struggle for breath when a man loses consciousness from CO poisoning or an airman flies to a dangerous height. In phosgene poisoning there is usually no great struggling for breath, as the CO_2, which stimulates the respiratory centre, can easily be got rid of in the lungs.

We can now see that the patient is in the gravest danger and constantly going down the hill from the cumulative effects of want of oxygen, but we cannot undo the damage done to the exquisitely delicate alveolar epithelium; much less can we replace it. We know, however, that if we can keep the patient alive, by obviating secondary dangers, the lung epithelium will of itself return to normal or something like normal. Now it is evident that by the continuous administration of air rich in oxygen we can meet the pressing danger and progressive damage from want of oxygen. To make this administration practically possible it is necessary to have proper apparatus, and I recently devised an apparatus for the continuous administration of oxygen, so that not more is given than is actually required, and none is wasted. This apparatus is in successful use in the clearing stations of our Army, and I hope that apparatus of a similar or superior type may soon be applied

in ordinary medical practice for use in the numerous cases where oxygen is, so far as I can judge, required.

By giving oxygen we do not cure the lung inflammation. It might, therefore, be objected that in the long run oxygen is useless, and only prolongs suffering. I wish to emphasise very strongly that reasoning of this kind is radically fallacious, and strikes at the root of practically all medical and surgical interference. What we do by giving oxygen is to keep the patient alive, by preventing secondary injury, until time has been given for the natural processes of recovery of the lung. We are breaking a vicious circle, for the want of oxygen produced by the injury to the lung is hindering, or making completely impossible, recovery from the injury. When the want of oxygen is removed, recovery can take place in a normal manner.

Medical or surgical interference of almost any kind amounts to the same thing. By treating a wound antiseptically or aseptically the surgeon breaks another actual or potential circle; for it is the infection rendered possible by the wound that prevents the wound from healing. The natural healing process is free to go on when infection is got rid of. By the use of anæsthetics another potential vicious circle is broken; and similarly by the use of splints, of operative interference, or simple rest. It is exactly the same with regard to the use of all varieties o drugs. With digitalis or strophanthus, combined with rest, we can often break a vicious circle in heart disease; with thymol we break a vicious circle in ankylostomiasis; with drastic measures for reducing body temperature we break a direct vicious circle in heat-stroke. When the vicious circle is broken, Nature is enabled to re-assert herself. Normal regulation of the circulation returns in valvular disease; the hydræmia, with all that it implies, is recovered from in ankylostomiasis; the normal physiological control of body temperature is recovered in heat-stroke. But at the back of all medicine and surgery is the old-fashioned *vis medicatrix naturæ.* Without this there would be no such thing as medicine and surgery. We cannot repair the living body as we repair a table or a clock. The surgeon is not a carpenter, nor the physician a mechanician or chemist.

Medicine and surgery are always counting on, and trying to understand and aid, the *vis medicatrix:* they evidently cannot get on without it. Here I think we touch the subtle barrier which causes the estrangement between practical medicine and the teaching of the preliminary sciences; for these sciences, as ordinarily taught, pay little or no attention to anything corresponding to the *vis medicatrix.*

Now let us try to analyse a little more closely what is wrong in the gas-poisoning case. The patient is in urgent danger from want of oxygen. But if we measure his actual intake of oxygen we shall probably find that, owing to his restless condition, it is above, rather than below, what is usual for a man lying in bed and without food.

He is only short of oxygen in the sense that the partial pressure of oxygen in the blood of his systemic capillaries is too low for the proper support of life, though there is still much oxygen left in even the venous blood. When he was still moving about, just before being put to bed or laid on a stretcher, his oxygen intake was far above that of a resting man. Yet probably his lips were already blue, and he was in imminent danger of sudden death from shortage of oxygen. This shows clearly that not only must the blood supply an amount of oxygen proportionate to the very fluctuating demands at different times, but the oxygen must at the same time be distributed at a certain partial pressure or concentration. When we measure the oxygen pressure of the venous blood in a normal person it is extraordinarily steady, in spite of considerable variations in its rate of consumption. This relatively steady normal is no longer maintained in the patient, and his symptoms of oxygen want are due, not to an abnormally low rate of intake of oxygen, but to a failure in regulation of the manner in which the oxygen is distributed. The truth is that in a normal person the oxygen supply to the tissues is, like everything else in the living body, regulated minutely from minute to minute. To the *vis medicatrix* of the sick body there thus corresponds a *vis directrix* in the healthy body; and just as the *vis medicatrix* restores both structure and function in the sick body, so the *vis directrix* regulates at every moment the activities of the healthy body. The *vis medicatrix* and *vis directrix* are evidently one thing.

This is an old-fashioned and very gross method of expression, but it at least points to the great salient facts which distinguish an organism from such machines as we know, and completely differentiate medicine from all mechanical and chemical arts. To put the matter in simpler and less misleading language, it is organic regulation of both structure and activity that we are constantly trying to aid and supplement in medicine and surgery.

I do not wish to go into the question whether organic regulation is, or is not, ultimately reducible to mechanism. On this point I have fully expressed my own conclusions elsewhere, but they need not directly affect the matter we are now discussing. My immediate point is this: that in practical medicine the assumption of the existence of organic regulation of both structure and function is absolutely fundamental. Disease is the breakdown of this regulation at one point or another; and practical medicine is simply assistance to Nature in restoring and maintaining effective organic regulation.

Now let us turn to physiology as it is usually taught at present. On consulting a current text-book of physiology one finds an account of the mechanical and physical aspects of each bodily process taken separately. For instance, in the case of breathing, there are descriptions of the structure of the lungs, the mechanism by which air is

driven in and out of the lungs, the chemical changes in the air breathed, the means by which gaseous exchange occurs in the lung alveoli, the nervous channels by which inspiratory and expiratory impulses are conveyed from the respiratory centre to the muscles, and the chemical and nervous stimuli which act on the centre. All these things are systematically described one by one, as we might describe the structure and action of a machine. But there is something which is almost totally lacking, for there is no description of the organic regulation which absolutely dominates all the mechanical and chemical details.

When, for instance, we examine the pumping movements of the respiratory muscles we find that they are determined by what is required to maintain at a practically constant partial pressure the carbon dioxide and oxygen in the arterial blood leaving the lungs. If the carbon dioxide production and oxygen consumption are increased ten times, the ventilation of the lungs will also be increased nearly ten times, so as to prevent more than a very slight increase in the carbon dioxide pressure of the blood. If the carbon dioxide percentage in the inspired air increases there is a corresponding result. If the oxygen pressure in the arterial blood tends to fall, it is kept up partly by increased breathing and partly by active secretion of oxygen inwards by the lung epithelium. Failure in these regulative activities produces urgent and dangerous symptoms.

Here, therefore, we have constant, unmistakable, and exact regulation of the quality of the arterial blood by the breathing, and if we examine the structure of the lungs and the nutritive process by which this structure is maintained, the constant teleological regulation or maintenance of structure is no less evident. Now the very expression "teleological regulation" evokes at once emphatic repudiation from most physiologists, as they consider that it savours of mouldy metaphysics. Let us, they argue, keep to facts capable of definite experimental verification, and avoid all doubtful interpretations of them. This, for instance, is what Huxley expressly aimed at in his admirably written *Elementary Physiology*.

Now I entirely agree with this contention; but the question remains as to what *are* the facts. It seems to me that, quite unconsciously, Huxley, and the whole physiological school which he typifies, misrepresented them very seriously, and in the manner which is really responsible for the existing and very detrimental estrangement between practical medicine and the preliminary medical sciences. It is quite evident that the breathing is regulated in the manner just described. One can verify it with the greatest ease. But if we teach physiology as if it dealt with a series of essentially unconnected events, like the workings of the separate parts of a machine, we misrepresent the facts.

We know, for instance, that under ordinary conditions the presence of a certain very minute excess or deficiency in the pressure of carbon

dioxide in the alveolar air will cause great increase in the breathing, or bring natural breathing to a complete standstill. This seems simple and definite; but as soon as we alter the conditions by diminishing the normal pressure of oxygen in the air, or interfering with the circulation, or over-driving the muscles, or making the diet abnormal in certain directions, or in various other ways altering the "normal" conditions, the statement is no longer true. The definite effect of the CO_2 is no longer the same. The effect depends very directly on the normal functioning of the body as a whole, and its immediate environment; and when we consider the alteration in the effect we find that it is again regulative in the sense of contributing to maintenance of the normal, though in a wider sense than before. Thus we have still before us the fact that bodily functions and structures with their immediate environments have the peculiar characteristic of tending very strongly to maintain the normal. The parts and workings of a machine show no such behaviour.

To take another instance: we know from the investigations of Hering and Breuer that distension of the lungs to a certain point inhibits inspiration and initiates expiration, while emptying the lungs to a certain point has the converse effect, these effects being reflexes of which the vagus nerve is an afferent channel. By itself this knowledge was quite unintelligible. It seemed to suggest that inspiration and expiration are events following one another in response to certain stimuli which are quite independent of the gases in the blood, whereas we now know, as already pointed out, that it is the gases in the blood that immediately regulate the breathing. But further investigations have recently shown that the degrees of expansion or contraction of the lungs at which the reflex occurs are dependent on the blood gases. If, for instance, the carbon dioxide in the blood is first reduced by forced breathing, so that the state of apnœa is produced, the slightest expansion of the lungs will initiate expiratory effort, while the slightest contraction will initiate inspiratory effort. Hence the breathing movements are jammed, and if we attempt to apply artificial respiration by Schäfer's or any other method unaccompanied by considerable violence, hardly any air passes in and out. If, on the contrary, excess of CO_2 is allowed to accumulate in the blood, the reflex is so modified as to permit of deep inspirations and expirations. Organic regulation thus dominates the reflex, and the account of it which has passed muster for fifty years is thus imperfect. A very large and quite common group of clinical symptoms, including those with the military designation of "disordered action of the heart" and "chronic gas poisoning" appears to be due to an upset of this reflex, with consequent very shallow and therefore rapid breathing, and want of oxygen and excess of CO_2, with all that these bring with them.

When we examine the circulation we find the same kind of con-

stant regulation from minute to minute as in the case of respiration; and it is the breakdown of the regulation that we have to do with in illness. But of this regulation we are often given hardly an inkling in the text-books, though there are abundant and tiresomely minute details about the mechanics of the circulation.

It is the same with the kidneys. There are long and very inconclusive discussions of the possible mechanisms of secretion, but hardly any attention is given to the absolutely dominant fact that, in whatever way the kidneys accomplish it, they are constantly engaged in regulating the composition of the blood with a fineness which is almost incredible till one attempts to measure it quantitatively in the same way as the fineness of regulation of the breathing or circulation is measured.

To whatever part of physiology one turns one finds evidence accumulating of the fineness and omnipresence of organic regulation. One necessarily misses this regulation entirely if one takes processes and organs one by one, and not in relation to the whole life of the organism. Illness is disturbance of organic regulation: consequently physiological teaching which disregards organic regulation has but little direct reference to medicine, and can be of relatively little help. A capable doctor has to neglect, to a large extent, the physiology he has been taught, and he has to make for himself a new, and often very crude, physiology.

If modern teaching of physiology is defective, so, to a far larger extent, is that of anatomy. Human anatomy frankly professes to deal only with the gross structure exhibited by dead bodies, whereas medicine has to deal with the living body. Now, it makes all the difference whether the body is alive or dead. The living body maintains, by a process of ceaseless and exquisitely regulated activity, the appearance which we call its structure. In disease the regulation is disordered, and in the process of recovery we see the restoration of this regulation. But anatomy disregards completely both the activity and the regulation of it. It frankly does not profess to tell us anything about the conditions which determine the fact that normal and not abnormal structure is present. Of the possible presence of a *vis sculptrix* corresponding to the *vis medicatrix* it has never even heard. "Natural selection or a Creator have just made structure what it is," say the anatomists, "and we cannot give any further information." The medical man has to struggle how he can to solve the problems which arise when either disease or he himself interferes with normal structure. Anatomy does not stretch out even a finger to help him in this struggle: it deals only with the dead. What help there is comes from experimental embryology and physiology, the recent work of the Edinburgh Physiological School being specially prominent in this direction. In this country the physiologists have annexed to themselves the study

of the microscopic structure of the body, besides inventing, in addition, an ultra-microscopic structure. Of the great future science of experimental anatomy only the germs exist at present. Human anatomy behaves as if she had sold her scientific birthright for a sorry mess of what may be called "systematic" pottage.

Pathological anatomy has, of course, suffered from the same deficiencies as normal anatomy. To many medical men the pathologist is a sinister figure which stalks behind the chaplain and in front of the undertaker, and which is constantly peering over the shoulder of the consultant and whispering suggestions of morbid changes which, like the normal anatomical structure, just come out of the blue, and which hopelessly sentence a patient to death or permanent disability. My intellectual as well as moral sympathies are all with the cheery general practitioner whose motto is "Never say die," and who flashes defiance at this dismal ghost.

On the side of abnormal function pathology is, of course, quite as active as physiology, but seems to me to suffer grievously from the defects of physiological teaching. For, in the main, experimental pathology sets out with the same limitations that keep the physiologist out of contact with practical medical work. When the normal organic regulation of physiological activity is almost ignored by physiology the pathologist is, of course, diverted from laying his finger on the nature and causes of failure in the regulation and on the processes which lead to that re-establishment of regulation which constitutes recovery or adaptation.

Let me give one more illustration from my own experience. Work on the health conditions at metalliferous mines, quarries, and factories brought me into contact with the terrible phthisis mortality which sometimes results from dust inhalation. The effect is mainly due to siliceous dust, such as that from the Craigleith sandstone formerly used in Edinburgh, or from millstone grit, gannister, Transvaal quartzite, or the powdered flint used for pottery work. But in many industries men are also greatly exposed to dust, and even dust consisting largely of crystalline silica; yet no excess of respiratory trouble attacks them. Coal-miners, for instance, breathe much dust, and with it a great deal of siliceous dust, but suffer even less from phthisis than agricultural labourers; and one finds men who have worked for decades in very dusty crushing mills, where extremely hard stone is crushed, containing 70 per cent. or more of silica, and yet they show no signs of ill effects. It seemed clear that much is hidden behind the name "pneumoconiosis"; but what? Evidently the first thing to do was to find out whether, and by what means, the lungs get rid of a harmless dust, such as coal-dust or shale-dust. The microscopic work was carried out by Mr. Mavrogordato at my laboratory, with the financial support of the National Medical Research Committee, and resulted

in showing that though with ordinary exposures the harmless dusts enter the lung alveoli in large amounts, the dust is all got rid of after a certain time. It is carried out by dust-collecting cells along several paths. In the case of pure siliceous dust, however, the transport fails, or is very slow, though the dust is collected in cells as before. The dust-containing cells remain, therefore, in the walls of the lung alveoli and elsewhere, with results which ultimately become disastrous. When, however, there is a mixture of siliceous dust with the ordinary dusts which stimulate transport, the whole of the dust is carried out.

Hence, as soon as we got some understanding of the normal regulation of dust elimination we could lay our fingers on how this regulation breaks down in the case of pure siliceous dust, and suggest a possible remedy. If we had simply asked what the immediate effects of dust inhalation are, we should have got nowhere; for the immediate effects seem to be much the same for all kinds of dust, and if enough of dust is inhaled rapidly, pathological results follow in all cases. The proverbial black spit of the collier is in reality just as healthy a sign as the increased breathing caused by muscular exertion, or immunity produced by a vaccine.

In connection with the phenomena of immunity, pathology has not waited for physiology, but has gone ahead on the right lines and practically created a new branch of physiology on the way. In many other directions, however, pathology seems to me to have been kept back by the imperfect conceptions which hamper physiology and anatomy; and this is still more strikingly true of pharmacology. The truth is that anatomy, physiology, pathology, and pharmacology are all branches of the one science of biology, with no definite dividing lines between them; and all should be definitely and explicitly based on the distinctively biological conception of organic regulation. This marks them off from other preliminary subjects, such as mathematics, physics, and chemistry.

No doubt I shall be reproached for trying to re-introduce obsolete teleological conceptions into physiology and medicine, but I shall not attempt to deal with this reproach now. What I have tried to show is, that whatever may be the ultimate conclusion about teleology, there can be no doubt that practical medicine is based on a teleological conception of the working of the body, and that because physiology, as ordinarily taught at present, ignores this conception, there is but little living contact between physiology and medicine as a curative art. In other words, physiology, and with it the other preparatory biological sciences, is not taking its true place as Institutes of Medicine, to use the Scots name. This is my diagnosis of the main underlying cause of the want of connection between these sciences and medicine.

As to the remedy, this lies mainly in the hands of the teachers; but I think that the defect is now tending to disappear. The days

of too exclusive attention to muscle-nerve preparations, the mere physical structure of dead tissues, and the mere chemistry of the body fluids and dead tissues, is past; and human physiology is taking a more and more important place in research and teaching. With the human subject of experiment the teleological mode of approaching physiological problems is inevitable, and *pari passu* physiology is coming closer to medicine. The study of immunity is also tending to bring pathology closer.

I have criticised the present-day teaching of physiology, anatomy, and pathology, but I want now to urge with all the emphasis I can that whatever may be their present shortcomings, the group of preliminary sciences represented by physiology, anatomy, pathology, and pharmacology form the future basis of practical medicine. The rest is only subordinate detail, changing from year to year and from place to place, and only surviving through the contributions it is constantly making to these sciences. Practical medicine is one of their active growing points—perhaps I should say their main active growing point—nourished by the mother earth of new experience. The medical art which is not grounded on these sciences is bound to become more and more of an anachronism. Treatment can only be securely founded on a correct and full diagnosis of what is amiss in organic regulation and how Nature can be aided in restoring the regulation. But diagnosis is far more than the mere giving a name to a morbid condition. The practical problem is always as to how in each particular case there is deviation from health, and how in each particular case Nature can be aided. In solving these problems scientific knowledge is indispensable. It is "with brains, sir," that the physician mixes his prescriptions and the surgeon guides his knife.

This means that the preliminary sciences must go with the medical man to each bedside and guide him at every step. As regards clinical demonstration and instruction in medicine and surgery, I think it means that we must more effectively install the active prosecution of the preliminary sciences at the bedside, and not merely leave scientific investigation behind in special laboratories. The diagnosis and treatment taught to students cannot possibly be progressive unless the teachers are progressive in the personal prosecution of scientific knowledge. At present the majority of medical and surgical teachers are so busily engaged in private practice that they cannot devote the necessary time to the details of scientific research, with its ever-increasing complexity of methods. I wish, therefore, to make certain suggestions for the remedy of this state of matters.

In the first place, it seems to me essential that real clinical laboratories should be established to help in the investigation of living patients and methods of treatment. A single good room in connection with the service of each visiting member of the hospital staff would

probably suffice for this purpose. For the research work to be carried out in each laboratory it would be absolutely necessary to have the services of a competent paid assistant. His duties would be, firstly, to carry on research work under the general direction of the physician or surgeon, and, secondly, to act as the intelligence officer connecting each clinical laboratory with the main university or other laboratories, and with other clinical laboratories. He would have to see to the details of experimental methods and get information as to how to work them. The apparatus and chemicals would only be what is needed for observations on normal or abnormal human beings, and this apparatus, when done with for the time, could be returned to a storeroom in the hospital, or to any other place from which it had been temporarily borrowed. Experiments requiring the use of animals or of considerable space would be much better done in the main university or other laboratories.

The appointments of such assistants would be very important, and would, I think, be much sought after. The work of these laboratories would bring new life and stimulus into the work of the wards, and would also, I feel sure, react with equally stimulating effect on the main laboratories. In my own experience practical human problems have always been an enormous stimulus to new physiological work and new ideas. The study and means of control of chronic diseases would, I think, benefit very particularly from these clinical laboratories.

Another suggestion which I should like to support is that the holders of chairs of systematic medicine or surgery should be freed from private practice. I cannot see how they can efficiently perform their very important duties otherwise, for they ought to keep in close and living contact with all parts of their subject, besides superintending the development of new forms of treatment and scientific investigation in the wards under their charge. The time has come, it seems to me, for placing these chairs on the same footing as other chairs in the Medical Faculty.

In a recent visit to America nothing struck me so much as the extraordinarily rapid development of medical teaching and research in the best universities. In place of the pompous ignorance of physiology and pathology which one meets with so often among medical teachers in Europe, there was everywhere considerable knowledge of, and enthusiastic belief in, scientific methods. Clinical laboratories, and keen young men to work in them, were appearing in all directions. Side by side with this clinical scientific activity there was an equally marked development in the pure scientific laboratories and their research work, and in the broadness of view which goes with originality. Other features were the introduction of whole-time professorships of medicine and surgery, and the system adopted by some of the leaders in American surgery and medicine of only carrying on private

practice in hospitals so organised and staffed that patients could be thoroughly examined, skilfully tended and observed, and placed in the best conditions for successful treatment. I returned home with the strong conviction that we shall soon be left behind in the medical sciences unless we can introduce radical reforms. It was largely this feeling that led me to venture to open the present discussion with the somewhat iconoclastic views and proposals which I have now laid before you.

Let me add some concluding words. A human being is far more than the mere organism with which medicine and surgery are immediately concerned. To a good doctor his patients, as fellow-men, have a value which cannot be measured; and he has constantly to deal with them on the human side and adapt his treatment to it. If he fails to do so he emphatically fails in his duty. In thinking of the scientific side of medical education we are sometimes apt to let the human side slip, and forget that an essential part of medical education consists of those subtle influences, exercised mainly by example, though partly also by special instruction, which teach sympathy with and understanding of human personality. If, therefore, medicine is to have more science and less rule of thumb, let us see to it also that with the science goes more humanity, and, where possible, a broader general education, not in the mere dry bones of the humanities, but on living humanistic lines.

IX.—THE POSITION OF SYSTEMATIC LECTURES IN THE CURRICULUM.

By Sir EDWARD A. SCHÄFER, F.R.S.

By the term *systematic lectures* I mean a complete instructional course given in the form of a regular series of lectures attempting to deal with the whole of the subject to the extent required by the student. For most of the subjects of the medical curriculum, such complete systematic courses are rendered unnecessary by the number of excellent text-books with which the student is furnished and from which the teacher can make his choice. By far the majority of people have a better visual than oral memory, and although a well-delivered lecture may be impressive at the time, the details soon fade, leaving little that is accurate. At the time that I studied medicine, and for a considerable time after, there was little or no choice of text-books—very important subjects, including physiology, had none which could lay claim to be either authoritative or accurate—and the student was compelled to rely entirely on lecture instruction. As a result of this, no student ever attempted to get up such a subject as physiology without attending the same course of systematic lectures twice—some

found it necessary to take them out even a third time. Nowadays, with the text-books we possess, it would be quite possible for a fairly intelligent youth to pass any theoretical examination without having attended a single course of systematic lectures. It may, it is true, be urged that the personal presentment of the subject by a man who is master of it is more likely to impress the important features upon the mind of the student than the mere reading of a book. But against this line of reasoning it must be pointed out that eminence in a subject does not always carry with it the gift of exposition to students; indeed, we must all of us have known eminent men who have been quite unable to fix the attention of a class on the subjects they have attempted to expound.

I may, perhaps, be asked, "Would you entirely abolish lectures and make the student learn his subject by reading and by practical work alone?" To this I reply, "By no means." I would, however, let observational work—a term which I use to include practical work of every kind—occupy the chief place in the curriculum; and this for all subjects without exception. Lectures may be given in connexion with the practical work, to show the bearing of observations—experimental or other—in illustrating the theoretical aspect of the subject. And in some subjects, not in all, a short introductory course of lectures dealing with general principles would be useful, although only *necessary* where the subject is unusually complex or strange to the student.

The introductory course I am contemplating must precede the regular instruction in observational work. Such a course would, as I have said, not be necessary in all subjects, but in some, such as physiology, which is vast in itself, and the principles of which underlie the whole study of medicine, an introductory course appears to be required, and would occupy a part of the preliminary period (first year) during which anatomy and microscopic anatomy are also being taught. It is a mistake to try to force students to acquire in a single academic year a proper acquaintance with the problems presented by physiology, considering that they come to the subject as entire strangers, having but little knowledge of anatomy and none of microscopic anatomy. The knowledge of physiology that they need for their examinations can only under these circumstances be acquired by a system of organised "cramming," which involves a serious strain both on teachers and taught. The teacher is compelled all the time to try and get a quart of instruction into a pint pot of intelligence, with the inevitable result that a large part of the valuable liquor he puts in brims over, and a disproportionate amount of his energy runs to sheer waste.

Although opposed to the continuance of systematic lectures, there is a class of lectures which I would willingly see encouraged, viz.

special lectures on a definite branch of the subject. Such special lectures should be given by a person who has made a special study of the particular matter to be treated of. He might be the professor himself, or one of his assistants, or one of the workers in his department, or an investigator altogether outside the university, invited personally to place before the students the results of his own work. Lectures of this description would be highly valued by the students, especially by those who take a keen interest in their work, and in my experience these are in the majority. Nevertheless, strange as it may sound, instruction of this nature, although encouraged elsewhere, is discouraged by the regulations of this university.

I cannot sufficiently accentuate that the great mistake in our present curriculum is the insisting upon a hard-and-fast rule for all subjects, and constraining the student to attend an unnecessary number of so-called systematic lectures in order to obtain information which he can get in far less time from the intelligent study of a good text-book. Different subjects of the curriculum require different methods of treatment, and the position which lectures should occupy in the teaching of one subject is not necessarily the criterion for another. More elasticity is required. Every experienced teacher knows how best to teach his own subject, and it may well be left to him to arrange the time which can be devoted to it to the greatest advantage of his students, without attempting to bind both him and them down to a cast-iron system which has become antiquated and ought to be discarded.

X.—THE RELATION OF THE PRELIMINARY SCIENCES TO THE CURRICULUM.

By Sir EDWARD A. SCHÄFER, F.R.S.

The position I take with regard to the preliminary sciences in the medical curriculum of the university is that they have no business there at all. Five years is the most that can usually be given by the student to the acquisition of the technical knowledge needed by the practitioner, and is all too short for the essentially medical subjects. It is not possible, or, if possible, it is not desirable, that this time should be added to. Five years is a large slice out of a man's educational life, and every additional year adds greatly to the expense of a medical education.

It is at last coming to be conceded that instruction in natural science—which includes physics, chemistry, and biology—must be an integral part of the education of every boy and girl up to about 16 years of age, sharing until then with other branches of education the time of the school curriculum. No subjects are more easily taught to

children than the natural sciences, by reason of the interest they excite and the objective manner in which instruction can be imparted. After 16, whilst the general education is being continued, a certain amount of specialisation would be allowed; this specialisation should be adapted to meet the needs of the career which the boy is intending to follow. Thus for law, or divinity, or a literary career the classics (including, of course, English) would occupy the prominent position; for commerce, modern languages and geography; whilst for a career to be devoted to manufactures or engineering or medicine, those branches of science which will be specially needed for the particular profession in view would be the important subjects of training.* It follows that a boy who intends to devote himself to the study of medicine, and who has already, by the time he has attained the age of 16, been grounded in the elements of the natural sciences, may easily receive by the time he is 18 the necessary training to enable him to understand their technical applications in the medical sciences proper. Such technical applications are not required, and are not desirable, until the medical sciences are themselves studied.

It is no answer to say that at most schools at the present moment a boy cannot obtain such instruction satisfactorily because the school science teachers have not themselves received the necessary training. It is the duty of the schools (and ultimately of the State) to provide suitable teachers and equipment, and to offer sufficient remuneration to attract first-class men to that as to other branches of the scholastic profession. It is equally the duty of the universities to train such teachers. To assert that it is impossible to train a sufficient number of science teachers to fulfil the functions required of them in the schools is an avowal of impotence in which I for one am not prepared to concur.

I am not dealing with the immediate possibilities of the case, although I am sure that much more could be done, even with these, than some of my scientific colleagues would have us believe. It has, indeed, been abundantly shown that the science instruction given in certain schools is already sufficient to enable boys of 18 not only to pass, but to pass well, such a really stiff examination as the Preliminary Scientific of the University of London. No doubt particular schools have laid themselves out to provide the teachers and equipment required for this purpose; but what can be done by some can be done by others, and the success of the experiment in their case is the best proof of the possibility of giving the proper sort of instruction during the school period. If this is carried out, we at once obtain an invaluable additional year for the study of anatomy and physiology, upon

* Obviously these need not be the same in every school. Some schools might particularise in the sciences required for engineering, others for chemical industries, others for medicine, and so on.

the knowledge of which the whole of medicine and surgery is based, but which are at present in our university practically restricted to a single year—a period quite inadequate for most students to acquire a sound knowledge of subjects so vast in extent and of such fundamental importance.

It is obvious that in a discussion such as we are engaged upon, viz. the improvement of medical education, it is our duty to aim at the ideal. It will help us little to tinker at the present condition of things; the changes which are needed are basic. The education of the country is about to go into the melting-pot, and there will be, it is to be hoped, some chance of adapting the medical curriculum to the introduction of natural science study into schools, which, it seems probable, will be the most prominent feature of any new system of general education.

DISCUSSION.

Professor Harvey Littlejohn.—I have rarely listened to a more enjoyable paper than that of Dr. Haldane. From the strictly practical point of view I do not see that it is possible to give as a part of the ordinary five years' curriculum—the minimum curriculum of our students—the instruction which he aims at in his paper. I do, however, realise that if a student, after he has passed the fundamentals and taken his degree, is going to be a successful practitioner—apart altogether from a successful surgeon or specialist—such further investigation on the lines suggested by Dr. Haldane would make him a much better man, whatever he intended his work to be. I fully agree that for our hospital physicians and surgeons it would be an inestimable advantage to devote their earlier years after graduation to such work as he has indicated, which is really one of the fundamentals in diagnosis and treatment. It is not, however, practicable to carry out a great deal of what he has indicated as useful in our ordinary teaching of the student.

In regard to hospital physicians devoting their whole time to hospital work, I scarcely think it is practicable, nor perhaps, in the majority of cases, advisable.

Dr. Haldane.—I only meant those professors who lecture systematically; not the physicians and surgeons.

Professor Littlejohn.—Provided we had a Professor of Medicine who had already acquired the experience that would enable him to be a thoroughly good physician and teacher at the bedside, it might be an advantage that he should devote his whole time to teaching.

In connection with what Professor Schäfer has said, I know that he has always been engaged too much systematically, and I am sure he has the hearty support of all of us who have for years been giving systematic lectures. We would like to get rid of them to a large extent, and I would be pleased if I could leave the student to get up the subject by himself from text-books, but so far as my subject is concerned, it is impossible that he could get it up from one text-book. The advantage of the systematic lecture is that, without presuming to teach the student everything he ought to know, we indicate the

more important subjects. It would be difficult for the students if we left them to grope alone in the larger text-books. It would, however, be a good thing to leave the student more to his own devices, merely pointing out the way to him, but making him use his own powers of observation to get there.

The preliminary education of the student is a debatable matter. I would agree with Professor Schäfer if we had a guarantee that the students would not be allowed to commence medicine before they were 18. I do not think it is possible before that age to obtain at school a sufficient knowledge of those preliminary scientific subjects for the study of medicine. In Scotland we get our students much younger than in England—at 16 or 17—and it would be quite impossible to trust to the teaching that they have got at school in chemistry and physics, botany and biology, to carry them effectively through their further courses in medicine. And we must remember that if we are going to burden the schools with teaching scholars the preliminary scientific subjects, we are doing it at the expense of that general culture without which no man becomes a successful doctor. It is the duty of the university not only to teach the elements of medicine, but to try and make the students men of sympathy, with a knowledge of humanity and a personal and kindly interest in their patients. These attributes play a very great part in making a man not only a successful but a good practitioner.

Dr. Byrom Bramwell.—Regarding the preliminary subjects, many of us agree with the view of Professor Schäfer that botany, natural history, and physics at all events, and perhaps also chemistry, should be passed before the student tackles the study of medicine ; I do not think that the argument brought forward by the Dean at all negatives this view. If a boy knew that he had to pass a certain standard in these subjects before he came to medicine he would probably not come up to the university until the age of 18. It would be an enormous advantage if we had these subjects settled with before the student comes to his life-work of medicine. If they were properly taught in the schools, the boys would get quite as much knowledge of botany, natural history, and physics as they do now—quite as much as is necessary for the medical curriculum.

I have been interested in the subject of systematic lectures for many years. I published in the *Edinburgh Medical Journal* of May 1909 practically the same views as those advocated by Professor Schäfer to-night. Twenty years ago I gave a lecture in the course of practice of medicine dealing with the subject of systematic lectures and examinations, etc., and ever since I have given to the students a reprint of that lecture that they might see what they were expected to do and to know. In this school too much importance is placed on systematic lectures. Medicine ought to be studied in the hospital rather than in the lecture-room, and the two courses ought, if possible, to be combined and carried on together. The ordinary course of systematic lectures is often misplaced and wasted. If you had a perfect lecturer in each subject, systematic lectures would be more valuable than the mere text-book. Often the student misses all sense of proportion in a text-book ; he does not know what is important and what is not. A systematic lecturer can emphasise each point as it comes up and drive it home into the student's mind. Nobody can get away from the fact that anatomy, physiology, pathology, and pharmacology are the preliminaries which are essential, and if the lecturers on these subjects would only emphasise the things which are

important for medicine, matters would be very much simplified. But in some courses the student gets a hundred lectures, and then comes to the wards knowing a great deal about physiological matters that are of no importance, and very little about others which are vitally important. It is difficult to teach these subjects as they have to be taught in Edinburgh at present, because the large majority of the men want to be practical doctors only. A certain number want a higher course of instruction, and of course the able physiologist, pathologist, etc., wants to go into all the details of his own subject and give the best possible course of lectures. I think it ought to be possible to contrive a course by which a certain number of lectures per week are given to the average man, to teach him what is practically necessary and nothing more, and then fill in, say, other two days in the week with higher lectures, which the average man might attend or not as he liked. Dr. Haldane's more elaborate method of teaching certain subjects would, I think, come in better as a post-graduate course.

I agree with him on the great importance of having a laboratory with a paid skilled assistant to work in connection with the physicians and surgeons of the hospital and to carry out their researches.

The question of having a Professor of Systematic Medicine without practice is an exceedingly debatable one. There are advantages, no doubt, on both sides, and I would not be prepared off-hand to say which is the better plan.

I cordially agree with Dr. Haldane in what he says touching the *vis medicatrix*. That there is a *vis medicatrix* everybody understands, but I do not see that that fact alone can in any way revolutionise the teaching of physiology. Everybody, of course, will agree that sympathy and personal character are of the greatest importance in dealing with disease, the mental attitude of the patient often having a most definite influence on the course of the disease; but those are things which we *may* be able to teach, but which depend largely on the character of the individual practitioner. Some practitioners have no power of impressing the patient.

PROFESSOR WATERSTON.—Professor Schäfer has told us that practically all the physiology the student wants can be learned from a text-book; but a considerable part of Dr. Haldane's address went to show how unsatisfactory was the presentation of physiology in text-books. In addition to altering the teaching of physiology, Dr. Haldane has almost laid the foundation of a new basis of philosophy. His paper suggests that a certain amount of lecturing is necessary where the philosophical principles upon which the subject is based would be set forth. I, too, think that such lectures are necessary, but to have them, we should need to add at least another year to the medical curriculum, because the very high plane on which Dr. Haldane has treated the subject is, I think, almost beyond the level of apprehension of the average undergraduate in the Scottish school. We must remember that they come to us in Scotland with a less wide general education than they do in England. It may possibly be because the Scots are slower in intellectual development, but they seem to be not quite able—save in exceptional cases—to face up to these very difficult questions.

Dr. Haldane was a little too hard on anatomy, which shares, I have no doubt, the criticisms he expressed on the teaching of physiology. I think there is already the beginning of the new spirit which he has indicated: we have to teach anatomy as a living subject. We shall do so more fully when

we get the thing more into our own hands. We shall only be able to carry out some needed reforms when we have a freer hand in the examinations and tests of the students, and when we may judge a man by his work throughout his course rather than by a formal test lasting only an hour or two at the end of it.

Dr. Edwin Bramwell thought it was important to consider the question of the time occupied by physiology in relation to the medical courses. There was, he thought, a general feeling among physicians in this school that physiology occupied too much time in proportion to the rest of the course. We believe that medicine and surgery are the most important subjects to the student, and we cannot help feeling that the time spent on physiology is perhaps unduly great. None of the students who have passed through physiology have anything but admiration for the instruction there, but they always say they have learned so much the application of which they cannot see. The result is that they lose all this when they come to us. Another of the students' criticisms is that, interesting though they have found the physiology course, they would rather spend more time over the subject that is going to be their life-work.

Regarding preliminary education. Professor Schäfer has advocated that the preliminary scientific subjects should be taught before the student comes to the university. If, however, he is to specialise at the rather early age suggested by Professor Schäfer, we are met with the great difficulty that we do not know what the boy's capabilities are. It seems to me that it would be very useful if boys after leaving school could only be placed for six months with someone—a very skilled individual—who could study their qualities and mental characteristics, and come to some sort of conclusion as to what line of life would be best suited to them. So many men seem to have missed their vocation

Dr. Ker.—The most profound remark we have heard this evening is that of Professor Schäfer on trying to put a quart into a pint pot. That came out when we were discussing anatomy. Some people appealed to the anatomist to cut down his subject and leave out some of the detail. The anatomist answered No to this, saying that the tiniest detail was often the most important. We can hardly expect to be any luckier with the physiologist. I was struck a fortnight ago with the words of the Professor of Anatomy when he said that the man who came back to him to prepare for his Final knew practically no anatomy. We know that that is not the fault of bad teaching; but what is the good of a great deal of the anatomy we learn? Are we not trying to overload the human brain? We would probably turn out more efficient practitioners if we asked them to learn a little less. I have been talking to some of the students lately, and, as far as I can make out, the modern student, in spite of his admiration for the physiology course, finds the experimental course largely a waste of time spent in collecting records which many of the collectors will tell you are faked. Would it not be better for the men to see these things done by really competent experts, instead of doing them badly for themselves? Another criticism of the students is that they are asked to get up for examination purposes a series of instruments which are out of date. Another point in my conversations with students that has rather interested me applies to the question of the length of the medical curriculum. I think we all agree with Professor Schäfer that it would be a good thing to get in

the extra year. Whether we would all want to give it to physiology I am not quite sure. We might share it, perhaps. But I heard, to my great astonishment, that very few students take advantage of that final year course of surgical anatomy. It was thought that there would be a run on it, but the students have so many classes that through sheer mental fatigue they do not attend this non-compulsory one.

Dr. J. H. Ashworth.—The proposal of Sir Edward Schäfer that the medical student should be taught zoology in school and not in the university is a change which, in my opinion, would react seriously against the interest of the student. The "atmosphere" of zoology as taught in a school would be entirely different from that found in the university. In the university department of zoology there are three or more teachers who give their whole time to the subject and keep in close touch with the recent work in their several branches. They have constant opportunities for the interchange of new ideas, so that whoever is in charge of the teaching to medical students is able to present the subject with a thoroughness, freshness, and breadth of view which could not be maintained by a single teacher in a school. This argument applies with still greater force in the case of universities like our own, where two teachers share the lecture work, so that the student has the benefit of the special knowledge of both. There is the further advantage that in the university the teachers of zoology are in intimate contact with those of the later subjects.

If in order to teach the preliminary sciences in school it is necessary, as suggested, to lengthen the school period by a year, there would be no gain in time to the student, who would profit more by spending that year under the better conditions obtaining in the university. This does not imply that natural history or elementary biology should not be taught in schools ; such teaching well done, together with encouragement to make observations on living animals in their natural surroundings, would be valuable and helpful. But the teaching of zoology to medical students, as I understand the method of treatment, is an entirely different matter, and should be retained in the university.

Dr. Dingwall Fordyce.—We have come to the time when it is necessary to think of lengthening the curriculum. This extra time will be claimed by the anatomists and physiologists or by the clinicians. I think we must define our terms, and find out what we mean by physiology and by medicine, and, on the other hand, where anatomy stops and surgery begins. Or, rather, what we want to define is where the teaching of physiology by the physiologist should cease and where the teaching of the clinician should begin. It seems to me that the teaching of the physiologist ought to be conducted in the sphere of the ward, that the teaching of the pathologist should be continued in the post-mortem room of the hospital, and that we ought to co-ordinate the two—physiology should stand side by side with clinical work.

Dr. Taylor.—I should like just to say a word or two about preliminary education once more, because, like all the rest of us, I too was at school once, and, unlike probably most of us here, I was an Arts student from an English school in a Scottish University. I think there is something to be said for Professor Waterston's statement that—in the Arts Faculty at any rate—the English boys knew more literature and were generally better educated than

the Scots boys. In my day, for instance, the Professor of Moral Philosophy nearly always found that the essays which stood out from the others were written by the English boys; they were better in style and structure than those of the Scots boys, though the matter presented by the latter was possibly deeper and more carefully thought out. As regards the preliminary scientific education, there seems to be a good deal of misapprehension. It would be quite possible to teach boys science and still to turn them out as efficient in English or other human studies as they are at present, or even more so. I know for a fact that in many Scottish schools the boys are turned out knowing quite as much physics—and knowing it better—as they get at the university, and almost as much chemistry. And the reason is this: in school they have time to assimilate the ideas put before them, and to grow into the subject in a way which they cannot for lack of time do at the university. I speak from experience as an examiner for the Leaving Certificates under the Scotch Education Department when I say that the present standard of chemistry and physics in the schools is almost sufficient, if not quite sufficient, to enable a boy of average intelligence to follow the principles of the application of chemistry and physics to the other subjects of the medical curriculum. It would be a tremendous advantage if these subjects could be finished with at school, leaving the full five years of the curriculum to be devoted to the later subjects.

Dr. Rainy.—There are two ideals in university teaching—the ideal that it should be limited to normal school teaching to train men for medicine, and the ideal that there is something beyond that, viz. to give men a vision beyond the mere qualification for their subsequent life-work. For each of these ideals a different line of teaching would have to be pursued. A great deal might be done in adapting our present course so that it would become not too difficult for the man who is going in for the profession simply as a means of livelihood and whose work will be such that he will be unable to do much laboratory research later on, but stimulating the better man at the same time to higher things. The point that interests me is, how far, maintaining the scientific outlook of physiology and pathology, the curriculum can be so moulded as to give the men the right ideas along lines that will be in touch with their work?

As regards the position of academic teaching of the first year sciences and school teaching, there is no doubt that a great many more facts can be got up by boys at school than later on, but when you come to the general principles, I do not think the schoolboy of 16 or 17 has quite reached the development of mind that delights in their application. Still, if those detailed facts were got up at school, it would enable the university teaching to be put on a higher plane than it at present occupies.

Dr. Traquair.—I am inclined to regard physiology as in a sense the preparation for the business of observation and inference which comes so largely into medicine, more perhaps than the other preliminary sciences. One notices so often in our students a deficient power of observation, which makes one rather inclined to disagree with the suggestion that observations and experiments should not be done by the students themselves, but should be done for them. Perhaps it is really the work of the clinician to teach the student how to observe and infer, but, after all, this training in observation

is *begun* in the physiology class, and this is one reason why it might be well to replace systematic lectures by exercises in observation and inference.

Dr. Chalmers Watson, after expressing general agreement with the speakers who introduced the subject, illustrated some of the defects in the systematic teaching of physiology from experiences he had had in hospital cliniques, where the students had failed to apply their knowledge of physiology to clinical problems. With regard to such subjects as respiration, the action of the diaphragm, and intestinal stasis, he thought that physiological teaching might be improved with benefit to the clinician. He also suggested that from time to time the clinicians might have the advantage of lectures from distinguished physiologists on the problems of physiology bearing on clinical work.

Mr. Wilkie.—We will all agree that in the medical course—whether five or six years—the student will only learn a very little that is of immediate practical value to him at the end of it, and that after graduating he has still a great deal of medicine and surgery to learn ; so that all we can hope to produce is a graduate who has been trained to observe a little what he will see in after years. In the teaching of physiology the practical and experimental part should play a large *rôle*, and that any lectures given should deal with general principles and lead the student to think out problems for himself. It is of great importance that physiology should not be isolated in a department of the university apart from the hospital, but that physiological study and experiments should be conducted in the wards of the hospital.

Professor Lorrain Smith.—The club, I think, is in unanimous agreement with the idea of the substitution of systematic lectures by practical work. It is also practically unanimous in its desire to bring the teaching of physiology more directly into relation with the actual work of the hospital. I did not gather quite clearly from Dr. Haldane's suggestion of laboratories in connection with the wards how far he would bring that in, not only as a means of investigating disease, but as a means of teaching the application of physiology to clinical problems.

I would like to ask Sir Edward Schäfer to what extent he thinks it would be possible to replace systematic lectures by practical work. This replacement will probably have to be considered in all subjects. No doubt it will be difficult to find a text-book which exactly fits the course of study that each individual teacher wants his students to follow, but if we agree that systematic lectures are to be given up to a large extent, the school will have to prepare a series of text-books which shall be adapted to its teaching.

Referring to the point that boys should have their scientific education in the preliminary subjects before they come to the university, it seems to me to mean this: they would spend another year at school, coming up to the university at 18 instead of 17. I do not quite see where the advantage comes in. That year has to be spent on scientific subjects, and would it not be better spent in the atmosphere of the medical school ?

With reference to the question of having research assistants in the hospital, I think this would be a good course, enabling us to introduce not only physiology, but anatomy, pharmacology, and pathology into the clinical teaching, and it would probably solve the problem of making the education of the student more continued than it is at present.

Dr. Haldane said in reply.—This has been to me a most illuminating discussion. Sir Edward Schäfer and the speakers who have followed him have covered points which have so greatly interested me that I have almost forgotten about my own paper! I wish to express my general agreement with what Sir Edward Schäfer has said, and with most of what the other speakers have contributed, and I will simply try to reply to some of the queries which have been raised as regards my own contribution.

I was sorry to find that I had given the impression that such changes in teaching as were proposed in my paper would lengthen the curriculum or make its standard a harder one for the student or teacher. The effect would, I think, be in quite the opposite direction. The structure and activities of a living organism hang together in organic unity, and there ought to be corresponding organic unity in the study and description of them. The phenomena of respiration, for example, are only intelligible in connection with those of nutrition, muscular activity, the blood and circulation, the activity of the liver and kidneys, the nervous system, and other organs. When we keep in view this organic connection, the necessary details are easily remembered; and, on the other hand, it is easy to omit masses of facts which are, in reality, relatively unessential, or which, in the present state of knowledge, cannot be properly interpreted, and therefore cannot be made use of. We want to impart knowledge that can be made use of, not useless unconnected facts. To my mind we could with advantage shorten, not only the systematic lecturing, but also the systematic practical instruction in physiology.

It is quality rather than quantity that students need from their teachers, and that the best teachers are anxious to give, and would often give much more effectively, but for the trammels imposed on them by uninstructed public opinion. I think that systematic lectures are very valuable if given by a teacher who puts his brains and soul into them, and is not compelled to give so many lectures that this is impossible. Looking back at my university career in Edinburgh, I have a very vivid impression of the influence brought to bear on me by lectures.

Clinical laboratories would simply carry forward into practical application the scientific training in the preliminary sciences, and would be used just as much for teaching and demonstration purposes as for original investigation. But I picture these laboratories as being more or less specialised in what each physician or surgeon is specially interested in, and I well know the kind of work I should myself wish to be doing. As a matter of fact, I am helping in doing some of it just now at the Canadian Hospital, Taplow, where Colonel Meakins, a distinguished medical teacher of M'Gill University, is in charge of the medical wards. We have got together a small clinical laboratory there, with apparatus for various special purposes, and are at present studying closely the nature and treatment of a large class of respiratory troubles in connection with gas poisoning, "disordered action of the heart," "shell shock," etc. In order to study these cases we have a bicycle ergometer for graduated exercise; mouthpieces, tubes, valves, bags, and gas-meters to measure the expired air; gas analysis apparatus to analyse it; and other special apparatus to record it quantitatively. We can thus analyse the enormous differences between the respiratory reactions of the patients and those of normal individuals; refer the abnormality to its real causes; devise

suitable treatment; and follow up its results. Anatomy, physiology, pathology, and pharmacology are all applied and carried forward in this work. Thus we have to take into account the anatomical arrangement, so laboriously worked out by Miller, by which air is distributed to the lung alveoli. The whole of the new physiological knowledge of the last few years as to the regulation of breathing and circulation, the blood gases, etc., is also involved, along with the pathology of oxygen want and the pharmacology of oxygen administration.

The preliminary sciences, properly understood and taught, place at the disposal of practical medicine an engine of tremendous power. This engine has hardly begun to be made proper use of in this country; and we shall inevitably fall far behind unless we speedily set our minds to the task of using it. In my paper I emphasised what seem' to be grave defects in the teaching of the preliminary sciences. But it also seems to me that the defects in the teaching of clinical medicine are perhaps still more grave; and I should like to take this opportunity of saying that I am in full agreement with Sir James Mackenzie in the sweeping criticisms contained in his paper, which I had not seen when I wrote mine. Contact with clinical medicine during the war has very deeply impressed these defects upon me.

In conclusion, let me say how great a personal pleasure it is to me to be back again in the midst of my old medical school, and to realise from the existence of the present inquiry, and the vigour with which it is being conducted, that this school means to keep the position it has won in the forefront of medical progress.

Sir Edward Schäfer said in reply.—If I were to enter into details in reply to those of my friends who have criticised or put interrogatories to me to-night I should detain you at least as many hours as you have already sat here. The discussion has indeed ranged from phonetics and the decimal system to the higher aspects of philosophy and the mathematics. I am, however, not prepared to go into any side questions, but there are one or two points in the main question which may perhaps be touched upon with advantage.

I wish, in the first place, to refer to Dr. Haldane's excellent address. He has suggested that it had been lost sight of. I beg to assure him that I have not lost sight of it, nor shall I easily forget the eloquence with which he has expounded his views. But I am bound to say that I do not understand some of his statements. For example, he told us that the organic regulation of the organism is neglected by physiologists, both in their text-books and in their oral expositions. I cannot conceive how such a statement can be made. If there is one thing that most teachers deal with at inordinate length it is the regulation of organic processes (by the nervous system, by internal secretion, and so on); insomuch that the student must get completely wearied by the iteration.

Dr. Ker has, it seems, gone to his students for their opinion as to the value of the instruction they receive. But a student is not always the best authority as to the value of methods of instruction. He can rarely appreciate the fact that the object of what I have called "observational courses" is to cultivate the faculty of observation. Some persons can never be taught to observe. They may become successful practitioners if they have a good bedside manner—which I suppose is still important—but the men who are making

a name at the present day are those who have carried the faculty of observation right through their career. They are, you may be sure, men who did not leave their physiology behind them after the second year, but took it on with them to all their later subjects, and brought it to bear upon their practice. Every clinician ought to be a physiologist. He cannot be a good clinician without being a physiologist. He cannot talk about the disorders of the heart or the nervous system without knowing about their physiology. We physiologists can only put before the students the general principles of our science ; we have no time for the details, although we endeavour to illustrate the general principles by concrete examples. We consider it of the highest importance to train the students in methods of observation. It is idle to say that they learn nothing from the study of the movements of the muscles of the frog or of the nervous system of the frog. These act in exactly the same way as those of man, and the students can learn the methods of observation in the one case as well as in the other.

Dr. Traquair asked how much the students study physiology on man himself. The answer is : "In every possible way." Working in pairs, they are expected to make observations upon one another in regard to the special senses, the circulation (pulse, heart, etc.), the respiration, reactions of the nervous system, and so on.

I am not prepared to accept Dr. Chalmers Watson's invitation to give you an account of what is known regarding the movements of the stomach and intestine. I will be satisfied with saying that the subject occupies an important position in the course of physiology, since it is one just now in special prominence, and I expect that many of you clinicians know a great deal more about it than I can pretend to.

I agree with Dr. Dingwall Fordyce that the teaching of physiology should never cease. Anyone who has the faculty of observation will go on adding to his stock of physiology all the time. It is the business of clinicians to continue the teaching of physiology in the later part of the student's course. On many questions, *e.g.* that of the electrical conditions of the heart in health and disease, the clinicians know more than many a physiologist. The clinician must not only be able to deal with normal physiology ; he should show the student how it is altered by the particular clinical condition under consideration.

With reference to Dr. Ashworth's expression of opinion, I have only to say that, although what he says is undoubtedly applicable to the higher teaching in his subject, it does not, in my judgment, affect the question of elementary instruction.

Many of the criticisms made to-night are answered by anticipation in my papers. The idea that the last years of the boy at school is to be devoted to science alone was in no way a suggestion of mine. I should let him go on with his general education, but, instead of specialising in Latin and Greek, he would, during his later years, specialise in the sciences which he will require later on in his future career.

As to examinations, my views on this question are strong ; but we cannot get rid of examinations altogether. I think, though, that a great deal might be done by substituting records of work. At present, for the degree examinations, we allow nothing even for the most complete records of practical work done. That this work is faked, as Dr. Ker suggested, is quite

impossible—at any rate in physiology—for we have means of ascertaining whether tracings and records are faked, and, be sure, we mark them accordingly!

In reply to Professor Lorrain Smith's question as to how one would replace lectures by observational work, I think a clinical lecture is as apt an illustration as I can select to point the moral which I desire to enforce. The way in which a good clinical lecturer will go over a case before him, illustrating one point after another by that case, and allowing his students to hear and see everything for themselves, is exactly what is wanted in all subjects. And I believe that more would be gained by the general adoption of such practical methods of teaching than by the compulsory attendance of the student at any number of systematic lectures.

RECENT ADVANCES IN MEDICAL SCIENCE.

SURGERY.

UNDER THE CHARGE OF

D. P. D. WILKIE, F.R.C.S., AND JAMES M. GRAHAM, F.R.C.S.

Amputations of the Foot in War Surgery.

Quénu (*Revue de Chirurgie*, March and April 1917), in an exhaustive review of gunshot wounds of the foot, gives an interesting record of the end-results of cases in which the various classical amputations through the foot and ankle had been carried out.

Only two cases of Lisfranc's amputation were examined, but in both the functional result was excellent. In ten cases of Chopart's amputation, which came under his personal observation, the functional result was very good in nine and poor in one. In several cases in which the function was excellent radiograms showed that the astragalus had tilted forwards, but that the os calcis had remained horizontal.

Reports from eight other surgeons showed that their experience with Chopart's amputation was not so favourable, and that out of a total of forty-eight cases the functional result was good in twenty-seven but bad in twenty-one. On investigating the causes of disability after this amputation it was found that one or both of two defects was present — either upward tilting of the heel had been permitted, giving an equinous stump, or the plantar flap had been too short, leaving a painful terminal scar. Quénu maintains that, contrary to a widespread opinion, the results from Chopart's amputation are admirable if the following points are attended to at the operation :—a generous plantar flap, stitching of the flexor to the extensor tendons, a partial tenotomy of the tendo Achilles, and fixation of the stump in a rectangular position for three weeks after operation.

In seven cases of subastragaloid amputation examined at periods of from six months to one year after operation the result was good in six and poor in one. In the latter an arthritis in the ankle-joint was found to be the cause of disability. On the whole, a favourable impression was created by the subastragaloid results, and in one bilateral case the result left nothing to be desired. It was found that the power of walking could be improved by a boot with two steel supports up the sides of the leg, taking some of the body weight from the tuberosities of the tibia.

Eight cases of Pirogoff's amputation came under review, under this term being included the modifications of Le Fort and Sédillot. In seven the functional result was very good, in one satisfactory, although in the latter the radiogram showed that the portion of the os calcis had slipped backwards off the tibia.

Only four cases of Syme's amputation were examined. In all the result was good, although in three there was a tendency to backward displacement of the heel flap, the edges having necrosed.

Taken as a whole, Quénu considers that operations conserving part of the foot do give excellent functional results, and strongly opposes the view of American orthopædic surgeons, who advocate discarding them altogether in favour of an amputation through the lower third of the leg which they consider as the modern "seat of election."

Gunshot Fractures of the Femur.

Eastman and Bettman (*Surg., Gynec., and Obstet.*, October 1917) record their experiences of the methods employed in the Austrian military hospitals.

Of the many types of splint used in the Austrian field hospitals, few have any value in securing extension, the three desiderata aimed at being immobilisation, easy access for dressing, and comfort in transportation. Moulded splints made of wire, tin, or cardboard are those most in favour, and whilst plaster of Paris is still extensively used, it is less so than in the early part of the war.

Austrian surgeons are agreed that the treatment of the infection, which is almost invariably present, must take absolute precedence over all considerations as to the position and alignment of the fragments, but in the base hospitals some form of extension is constantly employed. Adhesive strapping being practically unobtainable in Austria, extension is usually applied by means of strips of flannel fixed to the limb by mastesol. The latter occasionally causes irritation of the skin, and in such cases fairly satisfactory extension can be obtained by applying the upper of a large-sized shoe, well padded, around the ankle and making extension from this. In some fractures of the bones of the leg this device is a very useful one.

The Steinman pin and Schmerz clamp are very extensively used with very satisfactory results, local sepsis being rarely seen. When from the nature of the wound it is impossible to apply the pin or clamp to the lower end of the femur, the tibia at about 2 ins. below the knee-joint may be selected as the seat of application. The writers have not seen any cases of secondary bone trouble from the use of the transfixion pin or clamp, even where it has been used in close proximity to an infected fracture. This type of extension, combined with the use of a cradle splint, such as that described by Hey Groves, is a favourite method of treatment in Austrian hospitals.

In badly infected cases intermittent or continuous irrigation with hypochlorite solution has proved most successful, and as a deodorant and lymphagogue sugar, either in granular form or in solution, is widely used. The tendency of treatment in Austria is toward conservative measures, the field for operative methods becoming more and more restricted.

The Epithelial Healing of War Wounds.

The practice of secondary suture has led to a great hastening in the healing of war wounds. In a large number of cases, however, the local conditions do not permit of such suture, and large granulating areas are left to heal over. Vignes (*Le Progrès Médicale*, 20th October 1917) believes that delay in healing is due to repeated mild reinfection of the granulating surfaces, the defective epithelial ingrowth being caused by the tryptic ferment of the polymorph leucocytes which are attracted to the wound by the bacteria rather than by any toxic action of the latter themselves. He has found that when such wounds have been rendered clean, healing is greatly favoured by coating them with paraffin, as in the "ambrine" treatment of burns, the serum which collects under the paraffin forming an excellent medium for the growth of epithelium.

In cases where epithelial grafting is indicated he recommends the method of Reverdin, and considers that rapid healing may be favoured by causing a mild lymphorrhœa in the part by Bier's congestion, the antitryptic action of the blood plasma facilitating the growth of the grafts. When large areas have to be grafted, hernial sacs may be used as grafts, the endothelial surfaces facing outwards. Wederhake has had uniform success with the use of such endothelial grafts.

In cases where the granulations are flabby and œdematous, with copious discharge, he considers that the best dressings for preparing the surface for grafting are aluminium acetate in 1 per cent. solution and brilliant green in 1 in 1000 solution.

Occasionally after large scalp wounds with loss of substance a bare bony surface is left, to which no graft will adhere. By making small punctures through the outer table into the diploe, outgrowths of granu-

lations are caused, and these soon form a bed to which grafts will readily adhere.

PARTIAL GASTRECTOMY.

Balfour (*Surg., Gynec., and Obstet.*, November 1917) describes the method of establishing the gastro-intestinal continuity after partial gastrectomy for gastric cancer, which has now been employed for some time in the Mayo clinic with very satisfactory results. For many years the Billroth No. 11 method was employed with what, at the time, were considered gratifying results.

Four years ago the method of Polya, in which the cut end of the stomach is anastomosed to the proximal jejunum through a rent in the mesocolon, was adopted, as it appeared to allow of a more extensive gastric resection. The mortality from this operation in 104 cases was 14·4 per cent., as compared with a mortality of 13·2 per cent. in 318 cases in which the Billroth No. 11 method was employed.

For the past year a modification of the Polya operation has been practised, a long jejunal loop being brought up in front of the transverse colon and the cut end of the resected stomach anastomosed end to side to this. It is found to be the easiest and most rapid operation yet tried, and in a series of thirty-eight cases the operative mortality has been only 5·2 per cent. D. P. D. W.

NEW BOOKS.

Otosclerosis (*Idiopathic Degenerative Deafness*). By ALBERT A. GRAY, M.D., F.R.S.E. H. K. Lewis & Co., Ltd. 1917. Price 12s. 6d.

IN this monograph the author deals with a form of ear affection which has from the beginning been the *bête noire* of the aurist.

As will be seen from the title, he suggests as an alternative name the term "idiopathic degenerative deafness." It would serve no purpose to attempt within the space at our disposal to give an account of Dr. Gray's views and conclusions. The subject is discussed in six chapters—(1) Age and Sex; (2) Heredity; (3) Biological; (4) Pathological Anatomy; (5) General Considerations on the Pathological Changes; (6) Notes on the Treatment and Prognosis. The book is well written, and both letterpress and illustrations reflect credit alike on author and publisher. The contents are original and based entirely on Dr. Gray's personal observations. This being the case, it follows that the monograph is likely to prove of interest only to otologists, but it equally follows that every otologist should know its contents.

It appears to us that perhaps the author assumes too much when he expresses his belief that the experienced aurist can generally

diagnose otosclerosis—meaning by the term the presence of degenerative changes in the osseous capsule of the labyrinth. More particularly does such an assumption seem little justifiable when the question arises as to the presence of otosclerosis as a complication of chronic middle-ear suppuration, for it would be obviously impossible to distinguish during life between fixation of the stapes depending upon the change described under the term otosclerosis and a similar condition due more directly to the middle-ear inflammation. Perhaps the most interesting chapter of a most interesting and original work is that which deals with treatment. The author's view is that this should be employed to meet the requirements of each case. Thus if the patient be anæmic, or if there be reason to suspect poisoning either from intestinal or septic absorption, appropriate remedies should be employed. The author gives cases where marked benefit was obtained by acting on these lines.

We strongly recommend the work to all who are scientifically interested in otology.

Kala-Azar: Its Treatment. By U. N. BRAMACHARI, M.D., Teacher of Medicine, Campbell Medical School, Calcutta. Pp. 150. Illustrated. Calcutta: Butterworth. 1917. Price Rs. 5.10.

IN this work, which has been described as the "first up-to-date treatise in any language on the subject," the many forms of treatment which have been employed in the past are discussed, but the main object is to direct attention to the results obtained by the administration of antimony in various forms. The author, who was one of the pioneers of this method of treatment, claims that the results have exceeded all expectations. The disease, which was formerly associated with a mortality of 95 per cent., has "been brought within the pale of curable affections." During the past twenty years many remedies have been employed with a uniform want of success, though several have, on insufficient evidence, been claimed as specifics. Only time and further experience will show if we have really found in antimony a true specific for this terrible disease which has caused such an enormous mortality in certain districts of India. The book is well written and the illustrations are excellent. As a record of a thoroughly scientific investigation on the treatment of kala-azar it is commended to the notice of all engaged in the treatment of tropical diseases.

Injuries of the Face and Jaw and their Repair and the Treatment of Fractured Jaws. By MARTINIER and LEMERLE. Translated by Captain H. LAWSON WHALE, R.A.M.C. Pp. xx. + 345. With 168 Illustrations. London: Baillière, Tindall & Cox. 1917. Price 5s. net.

THE translator in his foreword claims that during the war no branch of surgery has emerged from oblivion and neglect to a position of

insistent importance to a greater extent than facial restoration. He has, in conjunction with Major Valadier, had a large and valuable experience of such work, and has, doubtless, justifiable pride in the success which has attended their patient and skilful surgery. When he says that anyone undertaking similar work will find this book most useful, due weight must be attached to his *dictum*.

We should have preferred to say that any engaged in similar work will read this book with interest. It is indeed an interesting manual, written with the precision and regard for strict classification so dear to the scientific mind of France. But the interest is mainly historical, and centres round the story of the art of prosthesis, which is defined as the art of making artificial substitutes for any organs cut off, whether by an accident or by surgical procedures. This is an art in which the skill and ingenuity of dentists have for long been exercised with varying measures of success. Claude Martin has been its most distinguished exponent, and Martinier and Lemerle are his devoted disciples. Their descriptions of the various forms of apparatus, the use of which they advocate, are admirably terse and intelligible.

At this time interest is inevitably concentrated on the joint surgical and dental treatment of projectile injuries of the face and jaws. Here we find this treatise adds comparatively little to our knowledge. The authors still believe that absolute fixation of a dental splint by means of cement is one *sine qua non* of success—a belief, it is only fair to state, shared by most of those engaged in treating fractures of the mandible. Nevertheless, surgeons will read this book with interest and dentists with profit, and will, as we do, congratulate Captain Whale on his excellent translation.

BOOKS RECEIVED.

CANDY, HUGH C. H. A Manual of Physics. Second Edition . . . (*Cassell & Co.*) —

CRAMER, W. Directions for a Practical Course in Chemical Physiology (*Longmans, Green & Co.*) 3s.

DEPAGE, Dr. A. Ambulance de "L'Océan" for July 1917 (*H. K. Lewis & Co., Ltd.*) single copy, 14s.

PENHALLOW, DUNLAP PEARCE. Military Surgery. Second Edition (*Henry Frowde and Hodder & Stoughton*) 21s.

SMYTHE, R. HARRISON. Wounds of Animals and their Treatment (*Bailliere, Tindall & Cox*) 6s.

SUTTON, Sir JOHN BLAND. Tumours: Innocent and Malignant. Sixth Edition (*Cassell & Co.*) 21s.

THORNE, LESLIE THORNE. The "Nauheim" Treatment in England of the Heart and Circulation. Fifth Edition . . . . (*Bailliere, Tindall & Cox*) 5s.

TREVES, Sir FREDERICK. Surgical Applied Anatomy. Seventh Edition (*Cassell & Co.*) —

WHEELER, WILLIAM IRELAND DE C. Handbook of Operative Surgery. Third Edition (*Bailliere, Tindall & Cox*) 10s. 6d.

WILLIAMS, LEONARD. Minor Maladies and their Treatment. Fourth Edition (*Bailliere, Tindall & Cox*) 7s. 6d

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EDINBURGH MEDICAL JOURNAL.

EDITORIAL NOTES.

Resignation of Sir Thomas R. Fraser.

PROFESSOR SIR THOMAS R. FRASER has intimated to the University Court his intention to resign the Professorship of Materia Medica.

CASUALTIES.

KILLED in action on 21st March, Lieut.-Colonel JAMES ROBERTSON, R.A.M.C.(T.).

Lieut.-Colonel Robertson was a graduate of Aberdeen University—M.B., Ch.B. (1904); M.D. (1908); Ch.M., with Honours (1909)—and practised in Aberdeen.

KILLED in action on 21st March, Captain BERNARD GORDON BEVERIDGE, M.C., R.A.M.C.(T.).

Captain Beveridge graduated M.B., Ch.B. at Aberdeen University in 1912.

REPORTED missing in East Africa on 5th August 1917, and now presumed killed on that date, Captain ERIC NEWTON, R.A.M.C.

Captain Newton graduated M.B., Ch.B. at the University of Aberdeen in 1912.

DIED of wounds on 27th March, Captain HERBERT TEMPLE LUKYN-WILLIAMS, R.A.M.C.

Captain Williams graduated M.B., Ch.B. at the University of Edinburgh in 1911.

DIED of typhus fever on 14th March, at Wei-hai-wei, ALEXANDER KIDD BAXTER, Medical Officer of the Coolie Labour Camp at Wei-hai-wei.

Dr. Baxter graduated M.B., Ch.B. at the University of Edinburgh in 1902, and subsequently went to China as a medical missionary.

KILLED in action on 25th March, Captain WILLIAM BROWNLIE, R.A.M.C.

Captain Brownlie was a graduate in Medicine (M.B., Ch.B.) of Edinburgh University, and of Arts and Science (M.A. and B.Sc.) of New Zealand.

KILLED in action on 23rd March, Captain DAVID CLEMENT CROLE, R.A.M.C. (attached to the Hussars).

Captain Crole graduated M.B., Ch.B. in Edinburgh University in 1905.

DROWNED while on service, Surgeon ALEXANDER FRASER MACINTOSH, R.N.

Surgeon Macintosh graduated M.B., Ch.B. at Glasgow University in 1915.

KILLED in action, Captain DOUGLAS WILLIAM HUNTER, D.S.O., R.A.M.C.

Captain Hunter, who was a graduate of Glasgow University and a D.P.H. of Cambridge, was awarded the D.S.O. in September 1916.

DIED on service, Captain WILLIAM TURNER, R.A.M.C.

Captain Turner studied in Glasgow, and took the Scottish Triple Qualification in 1900.

STUDENT OF MEDICINE.

DIED of wounds on 29th March, Lieutenant ALEXANDER SCOTT HARVEY, Gordon Highlanders, aged 21.

Lieutenant Harvey, who had been twice previously wounded, was a student at Edinburgh University, and obtained his commission from the O.T.C. in January 1916.

War Honour.

LIEUTENANT-COLONEL HENRY WADE, R.A.M.C., has been awarded the D.S.O. for services in connection with the operations culminating in the capture of Jerusalem.

Anatomical Nomenclature.

THE Anatomical Society of Great Britain and Ireland has passed and circulated the following resolution :—

The Committee, after consideration of the matter, unanimously reports that it sees no reason for departing from the use of the old nomenclature as the recognised medium of description for employment in anatomical text-books and departments, or by medical men in general : on the other hand, it thinks that there are very good reasons to be urged against the adoption of any other nomenclature for this purpose.

As the Basle Anatomical Nomenclature has already been adopted by all the standard text-books of anatomy and surgery, and several generations of students have been instructed in it, we do not expect that this reactionary step on the part of the Anatomical Society will have any effect in arresting a reform which has so many obvious advantages.

PRESENT-DAY OUTLOOK ON TUBERCULOSIS.

BEING THE INAUGURAL ADDRESS DELIVERED ON THE INSTITUTION OF THE CHAIR OF TUBERCULOSIS IN THE UNIVERSITY OF EDINBURGH, 16TH APRIL 1918.

By PROFESSOR SIR ROBERT W. PHILIP, M.D., F.R.C.P., F.R.S.E.

THE inauguration of a Department in the University affords fitting occasion for a statement of the circumstances which led to its inception and for a sketch of the outlook and purposes of the chair. A formal *apologia* is unnecessary, but certain facts and considerations may be put on record.

The Chair of Tuberculosis is the gift of the Royal Victoria Hospital Tuberculosis Trust. It is the latest expression of a policy which has gradually developed in the minds of the Committee of Management since 1887. The Committee were concerned with tuberculosis as a social malady of vast dimensions, responsible directly for at least one-seventh of the deaths of the civilised world, and indirectly for an incalculable amount of physical weakness and economic waste.

The policy had for a cardinal fact and starting-point the discovery—the recent discovery then—of the tubercle bacillus as the essential cause of tuberculosis in all its forms. Resting on that foundation, an endeavour was made to adapt to tuberculosis the great principles of prevention and treatment that were proving serviceable in the case of other infective diseases.

The year, 1882, is an important date in the history of tuberculosis, not merely because of the announcement of the bacillus, but as the dawn of a great renaissance in the study of the disease. The flutter caused by the announcement in histological and pathological laboratories is one of the romantic memories of medicine. In the laboratory where I happened to be working, the learned director literally danced with excitement, and routine work gave place to endeavour to determine or refute the claim.

FORMER HOPELESSNESS.

In the light of to-day, it is difficult to convey an adequate conception of the sombre outlook on tuberculosis in the seventies and more or less right back to the time of Hippocrates. Then it was the finished picture—the dying patient, or the mortality table—that commanded attention. The name, Phthisis, itself

suggests downward progress along a weary road towards an inevitable end. The master-draughtsmen and colourists of clinical medicine throughout the ages have painted an unmistakable portrait—the fragile frame, dropping flesh, pale skin, hectic flush, short breath, quick pulse, tiring cough, wearing fever, drenching sweats, and fading strength.

But these traits so graphically drawn are the traits of hastening death. The legend over the picture told of defeat, almost without contest: *Mussabat tacito Medicina timore* (Medicine, dumb with fear, scarce dared a word). Only the fateful, *Prognosis infaustissima.* And then, with an easy air of omniscience, the physician set about instituting conditions of environment which removed the last hope of natural resistance. The patient, whose illness was traced to exposure and "cold," was shielded in every possible way—literally wrapped in cotton wadding and placed in an incubator. And all this with a certainty of statement and procedure beyond question.

The mental attitude of the profession before the discovery of the bacillus was excellently reflected in the remark made to me by a distinguished member of the faculty when, on returning to work in Edinburgh in 1883, in reply to his question as to future line of work, I suggested tuberculosis. "Don't think of such a thing," he said. "Phthisis is worn to a very thin thread. The subject is exhausted."

Scientific Era.

By the recognition of the *causa causans*, we were switched, as it were, from the harvest field of disease to the sowing time—from consideration of the final manifestations of the life-history of the bacillus in the favouring medium of the patient's tissues to observation of the pathogenic organism under the more exact conditions which experiment makes possible. By the recognition of the bacillus, old popular premonitions as to the infective character of the disease—notably on the part of the Latin races—were seen to have a basis of fact. Scientific observations prior to 1882 as to the infective character of tuberculosis—such as those of Klencke, Villemin, Cohnheim, and Klebs—received conclusive endorsement.

The acceptance of the bacillus as the infecting agent was followed by countless investigations regarding its biology. Its characters were studied in discharges, in tissues, and in culture, and likewise its effects on tissues and media. With improvement

in histological methods investigation made rapid advances. The manifestations of tuberculous invasion wherever met with—whether in lungs, intestines, liver, kidney, peritoneum, glands, bones, joints or other tissues—were shown to be essentially the same. The unity of tuberculosis in its infinitely various manifestations, urged by Laennec in the beginning of last century on anatomical grounds, was now formally established.

Truer conceptions of pathology emerged. The toxic effects of the bacillus on tissues and functions were determined. Invasion of the bacillus meant intoxication of the system. Symptoms hitherto ascribed to progressive weakness were traced to the elaboration and circulation of poisonous products.

A number of diseases not previously regarded as tuberculous have been shown to be due to the bacillus, and additions are still being made to the list.

Universality of Tuberculosis.

Alongside the misconceptions produced by study of the late results of infection must be placed the misleading testimony of mortality tables.

A certain number of deaths in this country—say one-seventh of the total—was attributed to "phthisis." From the frequency of such deaths at certain ages, the disease was regarded as one especially of adolescence and early adult life. Curious theories were woven in explanation. What are the actual facts? Overwhelming evidence has accumulated showing that tuberculosis is practically universal.

The classic observations of Nägeli (Zürich) in 1900 are too well known to call for more than citation. He reported that definite signs of tuberculosis were found in 97 per cent. of bodies examined consecutively by him, that is, of persons dying in a general hospital from all sorts of diseases and accidents. Similar observations have been recorded by subsequent workers. The most recent—published in October 1917—are those of Reinhart (Berne), who, following the plan of consecutive post-mortem examinations, found that 96 per cent. yielded evidence of tuberculosis.

These citations might be multiplied. They all go to show that sooner or later most persons become tuberculised in some degree.

Infection in Childhood.

More important than the proof of the universality of the disease is the conclusion supported by convincing evidence that for the most part tuberculosis is acquired in childhood. Clinical, pathological, and experimental facts all indicate that tuberculosis is vastly common in childhood. While infants seem seldom born tuberculous, most children develop it in one form or another. The child's mucous membranes are specially receptive, and inoculation occurs readily at any point. The frequency of infection increases in each successive age group up to puberty.

These are but illustrations rapidly culled from an immense field. They are impressive and illuminating. If the natural history of tuberculosis is to be rightly comprehended and interpreted, we must brush aside the fallacies based on a time-honoured but mistaken pathology, and on mortality statistics which are misleading. We require observers with exact methods, possessed of scientific imagination and patience sufficient to overcome the difficulties inherent to the study of an infection so long drawn out—an infection which, while universal in distribution, is incomparably varied in expression.

A large part of laboratory observation suffers from the fault that the procedure is crude, hasty, and intensive. To get satisfactory results we must follow Nature's method of inoculation, which for the most part is unobtrusive, gradual, and repeated.

Declining Death-Rate.

Tuberculosis is a live, many-sided subject. Look at present-day facts. The ravages of tuberculosis are still appalling, but they have been greatly reduced. They are being met. In place of waiting till the bacillus has drained the life-blood from its victim, medicine is on the outlook for the first signs of attack. Effective forces have been mobilised. The invader is well in hand.

Take the Registrar-General's figures for England and Scotland in 1915. In England, 54,295 persons died of tuberculosis, representing a death-rate from all forms of 151 per 100,000 of the population. In Scotland, 7819 persons died of tuberculosis, representing a death-rate of 163 per 100,000. Restricting our view to pulmonary tuberculosis alone:—In England there died 41,676 persons, representing a death-rate of 116 per 100,000, and

in Scotland 5291 persons, representing a death-rate of 111 per 100,000.

If we go back twenty-five years and look into the mortality from pulmonary tuberculosis, the comparable figures are as follows:—In 1890 for England a death-rate of 168 per 100,000 as against 116 in 1915, *i.e.* a drop of 30·9 per cent., and for Scotland a death-rate of 193 per 100,000 as against 111 in 1915, *i.e.* a drop of 42·4 per cent.

The comparison shows that by some means or another a successful resistance is now being offered to tuberculous invasion which was not offered before.

That the remarkable fall is not due to natural causes which influence all civilised countries in more or less similar fashion is seen by comparing the 1915 figures for England and Scotland with the 1915 figures for Ireland, France, and Germany. The figures per 100,000 of the population run as follows:—Scotland, 111; England, 116; Germany, 142; Ireland, 172; France, 179. And the figures for Austria and Russia—less certainly obtained for the moment—are still higher.

Such facts afford striking commentary on the view maintained by Metchnikoff and others that a process of gradual immunisation is in progress in thickly populated countries through natural vaccination.

With the figures before us, we are faced with the question—If some countries are thus reaping the benefit of prolonged natural vaccination, why are there such striking differences in the various groups forming the older civilisations? If natural immunisation be the reason, why the difference in favour of Scotland over Ireland and France? If natural immunisation be the reason, why should Scotland and England show the strikingly low mortality (111 and 116 respectively) as compared with France (179)? The fascinating theory of communal immunisation on natural lines fails badly when tested by hard facts.

Fallacies in Returns.

Before leaving this part of the subject it is necessary to recall that mortality statistics as published by the Registrar-General include only deaths certified by the patients' doctors as having occurred from tuberculosis. It is common knowledge that many deaths occur from tuberculosis which are not thus certified, either because the disease has not been recognised, or because it has been described euphemistically. What the patient died of and what

he is said to have died of are not always one and the same thing. Many deaths are labelled as from pneumonia, bronchitis, measles, whooping-cough, or influenza, which are really referable to tuberculosis.

Take any one of our general hospitals, say the Royal Infirmary, or the Royal Hospital for Sick Children; go round the wards and follow a really exhaustive clinical examination of the cases. The amount of tuberculosis thus revealed will astonish you. The more refined the methods the greater will be your astonishment. Were it possible, in relation to the Sick Children's Hospital, to wipe out all the cases of tuberculosis applying for treatment, you would probably wipe out 50 per cent. of the whole.

Falling back on Reinhart's observations that 96 per cent. of all bodies examined by him presented tuberculous lesions, a further point of much interest emerges. Reinhart has made careful analysis of the cases, dividing them into two groups according as they showed an active or a healed lesion. He found that of the bodies presenting tuberculous lesions, 32 per cent. showed tuberculosis in presently aggressive form. In other words, about one-third of the hospital population, that is, of those who terminated their days within the hospital, presented post-mortem evidence of tuberculous disease in progress. In the remaining 64 per cent., while tuberculous lesions were present, these were, to all intents and purposes, healed.

Those details are remarkable and afford matter for reflection as we walk the hospitals or go about seeing sick people. It is in many instances to the co-existence of tuberculous disease that the mortality of other diseases is due.

When H.M.S. *Caledonia*, an old wooden hulk which had withstood many a storm, lay in the Forth as a training-ship for boys, we had one year from her at the Royal Infirmary many cases of pneumonia of vicious type, a large number of which were fatal. At successive port-mortem examinations the interesting observation emerged that in each case tuberculosis was present in the lungs. This is especially significant, because, as a rule, the outlook on pneumonia as occurring in a healthy young boy is good. Yet these boys died. Pneumonia was grafted on pre-existent tuberculosis. Tuberculosis was the factor that weighted the scales adversely.

This is similarly true of much which passes as bronchitis in old age. If we could remove the substratum of tuberculosis we would reduce enormously the morbidity of such affections.

Variability of Expression.

In whatever way you view it, then, tuberculosis is to-day a live problem teeming with issues which call for observation and investigation.

Look for a moment at its kaleidoscopic features. While the essential cause (the tubercle bacillus) and the primary lesion (the tubercle) are common to them all, how different are their expression in different cases!

The individual may be inoculated with tuberculosis at any point. The site of inoculation may be visible, external, cutaneous. More often it is concealed, internal, mucous. *Where* it occurs makes little difference. At the site of inoculation, the first line of defence, an obvious lesion (wart, chancre) may develop, or nothing may be traceable as commonly in the case of mucous surfaces.

When the first line of defence has been passed, infection is carried by way of the lymphatic system to the lymphatic glands. Lymphatic glands nearest to the site of inoculation first show change. The change may be limited to one area. The infiltration and swelling which occur are obvious expressions of invasion in progress and of resistance offered by the glands which form the second line of defence.

The infective process may be arrested at this stage. This is a serious testing-point of the patient's resistance. Individual glands react variously. They may enlarge gradually and uniformly, or the reaction may be excessive and acute. They may suppurate. They may become calcareous. The process may apparently exhaust itself—that is, be adequately resisted—in the lymphatic system. It is this fact, doubtless, that has given rise to the notion that immunity may be effected when the disease affects the glands specially. The true interpretation would seem to be that spread is arrested because the glands exercise a sifting and perhaps antagonistic action in respect of the invading organism. The seeming immunity is really nothing more than effective resistance of the glands which hold up the invader.

If, on the other hand, the barrier of the lymphatic glands fail, a more general invasion follows. There is now infinite possibility of disease. Bacilli may pass to any of the organs, or there may be a widespread involvement of the system through the bloodstream.

The clinical features of tuberculosis are similarly varied. Any

part of the body may present evidence of disease. In the case of the lungs, the course is never quite the same in any two instances. Some cases run an acute course and death follows in a few weeks; others may last twenty, thirty years, or more. Between these limits there are endless possibilities.

In addition to the local changes, the more progressive case always presents systemic disturbance. The effects of such intoxication show themselves widely throughout the body. More especially they prejudice the circulation and lead to wasting of muscles, both skeletal and visceral.

The expression, "kaleidoscopic," just used is not exaggerated. The variations, clinical and pathological—the combinations and permutations—are unlimited. The place occupied by tuberculosis in medicine is a large one. It has extensive relationships with pathology, clinical medicine and surgery, diseases of children, diseases of the eye, ear, throat, and skin. The man who devotes himself to tuberculosis need never become a specialist in the narrow sense of the term.

A Return prepared for me by the Registrar of the Royal Infirmary shows that during the year ending 31st January 1918 some 650 cases were treated for tuberculosis within the wards. The Return includes tuberculosis of practically every organ and structure in the body. The list refers to indoor treatment alone, and is exclusive of a vast number of cases of tuberculosis coming as out-patients to all the departments. The numbers are the more remarkable, inasmuch as the Royal Infirmary is a general hospital which, on principle, excludes infective conditions.

Diagnosis and Prognosis.

The diagnosis and prognosis of tuberculosis involve a minute and exhaustive estimate of the degree of local disturbance caused in the various parts of the body and a delicate appraisement of the amount of systemic intoxication. This implies the application of physiological and pathological methods at every turn.

It is not—as seems sometimes to be imagined—a matter of sending a sample of expectoration or other discharge to someone behind the scenes, who has never seen the patient, and of resting content with a positive or negative result of such examination. The bacteriological proof, because of its finality, is serviceable as affording a convenient delimiting line in connection with admission into the Public Services and the like. For the larger purposes of treatment and prevention it does not carry us far. It is open

to the fundamental and paralysing objection that the appearance of the tubercle bacillus in the discharge is a comparatively late event.

For the purposes of effective diagnosis much more is needed than this. We must sift the evidence afforded by the various organs and the system as a whole. The rough and ready way in which patients are commonly classified as having reached the first or second or third stage of tuberculosis will not do. The hasty fashion in which a man with pronounced physical signs of pulmonary tuberculosis used to be—and often still is—accorded his *congé* from earthly worries within a given term has done much to discredit medical practice. Many authoritative works on clinical medicine require thoughtful re-editing of this chapter.

The humour of the situation appeals grimly to the subject of the premature death sentence. An old hand once remarked to me with unconcealed gusto, "Don't be rash in your prognosis regarding consumption. When I was a youngster I was condemned by my family doctor and several of the leading consultants of the day as a bad life. No insurance company would look at me. Well, I have had the melancholy satisfaction of following to the grave all these doctors and some Insurance Managers."

It is a frequent experience to come across persons often in seemingly good health who were patients for extensive tuberculous disease twenty and even thirty years ago. Within the past day or so three patients have come to see me with the arresting introduction: "You remember, I'm a case of fifteen, eighteen, or twenty-five years' standing." In the fighting line at the various fronts to-day may be found many a man whose life once trembled in the balance from tuberculous disease.

Treatment.

Turning to treatment, the prospect is full of hope. The fact is realised that no disease is more tractable than tuberculosis, if its character be recognised sufficiently early.

Aerotherapy.

Nature herself cures tuberculosis every day. Half of us assembled in this hall are cases of arrested tubercle. The return of medicine to Nature's methods of cure is a story of deep human interest.

If the disease be taken in hand early, tuberculosis is readily managed. The principles of treatment are well defined. Their

successful application requires not only knowledge and skill, but complete reliance on the methods and infinite patience—patience on the doctor's part, patience on the sick man's part, and patience on the part of the patient's friend, the inevitable friend who always knows one better than both.

By the recognition of the eternal principle of aerotherapy and by fulfilment of physiological demands for rest, movement, and feeding, the treatment of tuberculosis has been revolutionised The parasitic invader has been countered by Nature's own methods. Disease has been seared from a soil rendered unsuitable.

For many years some of us have pled for the more general realisation of aerotherapy in the treatment not only of tuberculosis, but of disease generally. There is still a pathetic, tragic failure to appreciate the value in household and in hospital of this great cleansing, antidotal, and vitalising principle.

Thanks to the devoted labours for many a year of Dispensary Officers and Tuberculosis Nurses in the city, Edinburgh—particularly the poorer parts—has justly acquired the reputation of being one of the most open-windowed cities. Yet paradoxes meet us at every turn. One of the most striking is the relative infrequency of the open window in larger houses and in halls of learning and other places where men and women congregate and—*absit omen*—in institutions for the treatment of disease. My conviction is complete as to the view expressed by me many years ago that in the adaptation of aerotherapy to the prevention and treatment of disease, there exists the potential of successes comparable with those obtaining in surgery through the practice of aseptic methods. The principle of aerotherapy is the foundation of child welfare.

One of the difficulties we were up against in the early days was the mistaken view that consumption, as it was then called, was a disease of climate. Our forebears looked on consumption largely as one of the scourges of our climate. With little inquiry as to its frequency elsewhere, it was assumed to be dependent on the uncongenial elements, the grey sky, the east wind, and the haar from the Forth. The opinion was voiced by the man in the street, by our writers, and by our poets. It was expressed with painful bluntness by a distinguished citizen of Edinburgh, to whom I went in the hope of enlisting his powerful backing at the commencement of the committee's work. "I'll gladly," he said, "contribute all I can to send every poor consumptive soul away from Edinburgh, but you'll never convince me you can do any good to them here."

We are happily removed from those days in thought and practice. There is now general recognition of the fact that, as tuberculosis occurs everywhere, in like manner it may be cured anywhere.

Vaccine-Therapy.

Assuming that the larger physiological requirements have been met, can we direct treatment more intimately? Can we attack the tubercle bacillus within the system more directly? Is there a specific treatment?

This brings us to the possibilities of vaccine therapy and chemotherapy.

Vaccine therapy is represented by the numerous attempts to meet the disease by the use of products of the life-history of the bacillus as a means of cure. Many such products have been elaborated. Entire tubercle bacilli variously treated have been used, or the bacilli finely ground and emulsified. Extracts have been made from bacilli themselves and from the culture media in which bacilli have been grown. Such preparations constitute the considerable group of tuberculins available for treatment.

What as to the purpose and value of tuberculin therapy? Its aim is to stimulate the natural protective mechanism in the hope of attaining some degree of immunity. It seeks to activate the phagocyte and the parasitotropic elements of the blood. In this way local and systemic effects are induced, which are severally contributory to the therapeutic result.

So far it has been found impossible certainly to immunise an animal against tuberculosis, and no less difficult to secure permanent arrest of disease in a tuberculised animal. None the less there is evidence, both from the experimental and from the clinical side, that tuberculin therapy is efficacious. I am satisfied, as the result of continued observation since it was introduced, that tuberculin is of specific value. Some points relating to its use still require to be made clear. But the amount of evidence accumulated during these years leaves me in no doubt as to the favourable verdict.

Chemotherapy.

The remarkable success attained in the treatment of infections by means of organic arsenic compounds makes one hopefully anticipate similar developments from chemotherapy in the treatment of tuberculosis.

The aim of chemotherapy is the discovery of chemical substances possessed of parasitotropic properties, that is, capable of disturbing or destroying the invading parasite. The difficulty in the past has been that, for the most part, parasitotropic substances are also organotropic, that is, inimical to the living cells of the invaded body. The method of chemotherapy is illustrated by the use of arsenic in various diseases due to parasitic invasion, such as syphilis, trypanosomiasis, relapsing fever, and malaria.

There is no doubt that even in simple form arsenic is a drug of value in the treatment of the earliest manifestations of tuberculosis. When treatment by arsenic—whether orally or subcutaneously—is undertaken at the stage of multiple infiltration of lymphatic glands and maintained continuously for a prolonged period, remarkable results are sometimes obtained.

There is ground for believing that from the further development of chemotherapeutic experiment we are likely to obtain results in the treatment of tuberculosis comparable with our success in syphilis. There are many common features in the history of the two diseases from the point of inoculation through the lymphatic stage to the final visceral stage. It cannot be too much emphasised, however, that if tuberculosis is to be cured, treatment must be undertaken at the earliest possible moment. Following the analogy of syphilitic infection, it is relatively easy to effect a cure, provided treatment on proper lines be adopted at the stage of primary lesion or early secondary manifestations. It is another matter when gross organic disturbance has ensued, or extensive histological changes have been produced.

Prevention.

The cure of tuberculosis is closely linked with its prevention. This means the anticipative application throughout the community of the physiological principles and methods which make for the recovery of the individual.

Before the discovery of the bacillus, much had been done—more or less unconsciously—towards prevention. Legislative measures during half a century with regard to housing, factories, workshops, and other Public Health enactments all tended in the right direction. Along with, and constituting an important element in, the fall of the general death-rate, the death-rates from tuberculous disease showed a gradual and persistent drop.

Special Antituberculosis Measures.

But the discovery of the tubercle bacillus put us in possession of the key to the enigma. Henceforth, prevention rested on the sure premises that in tuberculosis we have to do with an infecting agent whose activity is governed by definite principles, and that it is possible to get rid both of the infecting agent and of the favouring conditions. It became clear that the principles which had proved efficacious in relation to other infective processes are applicable to tuberculosis. It was equally evident that by reason of the extraordinarily varying characters of tuberculosis, the application of these principles must be adapted and enlarged.

It was such considerations that led to the evolution of what is generally known as the Edinburgh Scheme. The first step was the recognition that there was a problem which had to be tackled and solved. Existing methods of handling tuberculosis, whether in private, or in hospital, or at out-patient departments, had largely to be scrapped, and a new order of things instituted. We had to get at facts. The infection had to be tracked in the household and in the community.

Notification was required. But valuable as notification might prove, it was clear that it would serve little effective purpose without the provision of facilities for the discovery, collection, and handling of patients on large scientific lines. Thus was realised the need for the creation of a well-equipped centre towards which persons possibly suffering from tuberculosis might be directed, and to which all inquiries regarding tuberculosis might be referred, a centre that would afford guidance to all sorts and conditions, giving immediate treatment in some cases, either on the spot or at the patient's home, and arranging for the transference of the varying types of patients to appropriate institutions and securing continuous supervision of the patient until the manifold risks of the long-drawn process had been sufficiently met. In this way was established (1887) the Tuberculosis Dispensary as the centre of antituberculosis operations for the community.

To be really effective, the Tuberculosis Dispensary had to be in close relationship with a variety of institutions, adapted to meet the needs of varying types of disease—the Sanatorium for early cases, the Farm Colony for more prolonged care and training, the Open-Air School, the Hospital for Advanced Cases, the After-Care Committee, and so on. These have successively developed.

The purpose of the Tuberculosis Dispensary was still larger.

In place of merely waiting to receive patients and directing their treatment, its officers went outside and sought to raid the haunts of the bacillus. In this way infected homes and households became the subject of exact examination and sympathetic consideration. The existence of tuberculous nests was determined, and infection spreading through households was detected at the earliest possible stage. Faulty environment in every aspect was investigated.

These and other procedures came as a natural evolution along with the widening of the rich and fascinating field of inquiry. The housing question assumed larger proportions. The site and structure of the house came under review, accommodation in relation to the number of inmates, amount of air and sunlight, sufficiency and suitability of food supplies and, generally, the degree of understanding in household management. In these and other ways much has been done towards a hygienic re-creation of the home.

The researches of numerous workers have accentuated the part played by milk in the production of tuberculosis and the urgent need there is for the adoption of uniform measures throughout the country to ensure a pure supply.

Relation to the War.

There is not time to dwell on the general adoption of co-ordinated antituberculosis measures. So far as the United Kingdom is concerned, the methods became stereotyped in the Report of the Departmental Committee on Tuberculosis. That Committee recommended the creation of a network of such antituberculosis schemes throughout the country.

The programme was beginning to be carried out. The several elements in the scheme were being forged according to the varying needs of different parts of the country. A special tuberculosis staff was in course of selection. Everything pointed to the establishment of uniform antituberculosis activity—when the war intervened.

Since July 1914 the movement has been largely held up. Schemes which were getting under way throughout the country have been crippled or stopped. Men chosen for the tuberculosis service have been hurried away to war service. Sanatoriums and hospitals erected for tuberculosis have been given up to wounded and sick soldiers. Buildings of all kinds in course of erection have been held up or diverted to other purposes.

The stern events of the war have, however, only thrown into sharper relief the urgent need for a wisely directed, comprehensive campaign against tuberculosis. With the continuance of the war there has been traceable in some parts of the country an increase in the death-rate from tuberculosis. Without discussing particular causes, the fact is significant. We are still up against an aggressive infection with immense ramifications, whose ravages can only be checked and overcome by unremitting effort along assured lines.

One encouraging fact has emerged during the war, namely, that the British Forces have suffered less than those of other Continental Powers. Dr. Hermann Biggs of New York, whose authority is acknowledged, has stated emphatically that France has suffered from the war in this respect infinitely more than Britain. He associates the result with the fact that in Britain the tuberculosis problem had been efficiently met before the war, while in France, on the other hand, practically nothing had been done.

The view is reassuring. But let us not plume ourselves overmuch. We must try to estimate the bearings of tuberculosis as occurring in the British war services. Officers and men discharged because of tuberculosis return to civil life and the State assures certain responsibilities towards them. With this in mind fullest use should be made of expert guidance available within the Services and outside, in respect of the examination of men before admission to the Services and in respect of the discharge of tuberculous men and their subsequent treatment and care. Men have been admitted to the Services who should not have been passed. Probably some have been excluded unduly. Men have not been discharged who had better have been and some discharged men might have been retained. After discharge the subjects of tuberculosis have too often drifted for lack of direction. This might in large part be obviated and the disturbing influence of the war be correspondingly limited.

Training in Tuberculosis.

A few words from the educational point of view. One of the outcomes of antituberculosis effort on the part of the State has been the establishment throughout the country of a tuberculosis service. Within the service are included tuberculosis officers of various grades, a large number of general practitioners, and also tuberculosis nurses and health visitors. It is manifestly

important that all persons engaged in the work, more particularly practitioners and medical students, should be afforded opportunities for training.

The need for it is prettily illustrated in the remark of a London tuberculosis expert, with whom I recently happened to raise the point. To my question as to how much he had learned of tuberculosis during his medical curriculum at one of the English universities he replied, "Of tuberculosis, just as much as I did of shipbuilding."

One of the findings of the Departmental Committee was "that additional facilities should be afforded to medical students and practitioners to acquire familiarity with the methods of diagnosis of tuberculosis, more especially in its earlier manifestations, and with the methods of treatment."

It was one of the original aims of the Royal Victoria Hospital "to promote the advancement of medical and surgical science with reference to consumption and allied diseases." Classes on tuberculosis have been conducted by members of its Staff for many years. When the Tuberculosis Trust came into being, the purpose was maintained. There was included among the objects of the Trust "the promotion of the scientific study of tuberculosis and allied diseases by founding and equipping or assisting to found and equip a Chair or Lectureship or Chairs or Lectureships in one or more of the Universities of Scotland, or by otherwise providing facilities for the study of these subjects."

In offering to the University of Edinburgh some £18,000 for the establishment of a Chair of Tuberculosis, the Committee of the Trust were, therefore, carrying out one of the purposes for which they existed. By the institution of the Chair they were ensuring, as far as they could, that the medical care and treatment of persons suffering from tuberculosis would be undertaken by men and women who had enjoyed special opportunities of becoming familiar with its protean features, its causes, treatment and prevention—men and women quick to recognise its earliest manifestations and keen to track the disease to its source.

By the Agreement concluded between the Hospital Committee and the Corporation of Edinburgh at the time of the amalgamation of the various institutions engaged in the prevention and treatment of tuberculosis in the city, a special clause was introduced providing that the Corporation should, in the event of the University of Edinburgh establishing a Chair in relation to tuberculosis, give all reasonable facilities for the purpose of the teaching of such chair in

connection with the tuberculosis work carried on in the Hospital, Dispensary, and Farm Colony, and for the purposes of research. This action on the part of the Town Council adds another to the numerous links which happily unite the Municipality and the University. It should prove of value to the community no less than to the University.

On many grounds it is desirable that the Chair should be in closest touch with the practical activities undertaken in relation to the care and eradication of tuberculosis. This is in line with the hope expressed by you, Mr. Principal, in your first Address to the graduates within this hall when, speaking more generally, you looked in the future work of the University for more direct relation to industrial requirements and economic problems. Our expectation is keen that, by intensive study and investigation in one department of medicine, greater results than anything accomplished in the past may follow in the common interest.

That outlook of the Chair was also in the mind of the late Principal. It is a vivid recollection of the year before the war how, on visiting the recently opened Tuberculosis Dispensary, Sir William Turner asked the question, "And what is to be the relationship of these various institutions with your Alma Mater?" The answer to the question lies in the foundation of the Chair, the proposal for which he warmly encouraged.

If the cynic raise the query, Why establish a chair for the study of a disease which it is proposed to exterminate, the members of the Trust, forestalling such realisation, have arranged that the scope of the chair should be defined in the Provisional Order sanctioning their procedure, so as to make it possible, when desirable, to include allied or other diseases within the activities of the department.

Research.

Before that time comes, however, there is a good long way to go. The natural history of tuberculosis calls for elucidation in many directions. With our hands on the key to the riddle of the ages, we are but feeling our way to its use.

We have discovered that the tubercle bacillus itself is not a fixed quantity. It varies under different conditions. It varies as it occurs in mammals, birds, and fishes. In mammals, in turn, it varies as it occurs in man and in cattle. We have got into the easy habit of speaking of a human and a bovine type. Yet an increasing body of evidence goes to show that the so-called bovine

type occurs frequently in man. The descriptive names are thus not quite apposite.

More than that. Numerous observations point to the variability of character in the human subject. Intermediate forms have been described with increasing frequency. What is the relation of those to the so-called types?

Biological variation is linked with varying degrees of virulence. The variations of tuberculosis expressed in terms of virulence afford a large field for research. Why the galloping pace in one subject? Why the snail-like creep in another? If tuberculosis is seldom transmitted directly from parent to child, what part does inheritance play in lessening or increasing resistance to infection? Is the tuberculosis of the adult the continuance or re-awakening of tuberculous infection acquired in childhood. Do re-infections occur? Granted that tuberculosis is almost universal and for the most part acquired in childhood, how comes it that the so-called bovine type of bacillus, frequently seen in children, is so seldom found in adults?

These are samples of numerous problems which await solution. Thorough investigation of the complex issues will need time and patience. There is much to occupy the attention of workers in the department for many a year.

An Object-Lesson in Medicine.

Meanwhile the study of tuberculosis is well calculated to make a man think regarding the meaning and course of all disease. In the variability of its expression, in the methods of diagnosis and prognosis, and in the far-reaching questions of prevention and treatment, tuberculosis affords a fine object-lesson in medicine. Its teaching is not limited to tuberculosis. It is luminous with principles which give just proportion to the facts of disease and inspire fresh effort towards the realisation of the ideals of health.

THE TRAINING OF THE STUDENT OF MEDICINE:

An Inquiry Conducted under the Auspices of the Edinburgh Pathological Club.

XI.—PATHOLOGY AND THE MEDICAL STUDENT.

By HENRY R. DEAN, Professor of Pathology, University of Manchester.

To the pathologist all things, at any rate all medical things, are pathology. The pathologist, if he thinks as I would have him think, must hold his subject to be the centre of all medical science and look on all others as grouped around it. Chemistry, physics, physiology, and anatomy interest him in so far as they supply the keys to problems which he has to face. Medicine, surgery, and gynecology represent to him branches of applied pathology—pathology applied to the treatment of disease on various specialised lines. All medical men are students of pathology, pure or applied, and without pathology no branch of medical science is complete. The complete pathologist must possess all medical knowledge, and obviously the complete pathologist does not exist. But, at any rate, the pathologist can say, "I am a pathologist; I reckon nothing which appertains to disease without interest to me." Now, these views are extreme views, the views of one who looks on his subject with enthusiasm, and who, perhaps, can hardly expect his colleagues to share his point of view. Nevertheless, I hold that views like these are necessary to any man whose business it is to teach pathology to medical students. Pathology is not a preliminary subject, the greater part of which may be subsequently forgotten, which serves a useful purpose in exercising and preparing the mind of the student who is about to proceed to the more serious matters dealt with in the final examination. It is not a special department of medicine, a series of elaborate and out-of-the-way methods of investigation, a sort of witchcraft practised by eccentric individuals in a laboratory, useful enough as an aid to diagnosis in certain diseases, but unessential, if not out of place, in the equipment of the practical man. Nor is pathology an independent science—such as some would make physiology—a specialised department of biology standing proudly aloof from the crafts of medicine and surgery. To my mind pathology and medicine form one whole, and it is as difficult to think of pathology without medicine as I trust it is impossible to think of medicine without pathology. The student of medicine must be first and last a student of pathology. He learns the elements of chemistry and of physics, he studies the structure and functions of the healthy body, and then reaches what is to be his life's work—the study of disease.

It is in something of this spirit that I would have the student

begin his studies in pathology: I should like him to feel, not that he is commencing another preliminary subject, but that he is at last beginning the study of disease—that he is laying a foundation of a knowledge of medicine. Medicine, surgery, gynecology, and pathology form one indivisible whole, and the component parts of this one science cannot be learned separately and piecemeal, for just as a knowledge of medicine must be based in part on the experience of the post-mortem room, so is a knowledge of pathology incomplete without the study of the manifestations of disease in living patients in the ward; for each disease is a process, a series of changes of which our conception is limited indeed if we confine ourselves to the picture of the final stage as seen in the post-mortem room.

The student, when he percusses the dull area in a case of lobar pneumonia, when he listens to the tubular breathing, should think of the anatomical and histological alterations which have produced these physical signs, of the progress and changes which these lesions may undergo, and so of the physical signs which subsequent changes may be expected to produce. The clinical picture of pneumonia should instinctively suggest the bacteriological aspect and possibilities of the disease, the microscopical appearance and habits of the pneumococcus, the organs which it may attack and the lesions which it may produce. In the same way a demonstration on a tuberculous lung in the post-mortem room should be the occasion for reflection on the signs by which the cavity, the areas of caseation, and the compensatory emphysema would have manifested their presence during the patient's life. In this way the quite artificial barrier which many a student builds up between pathology and medicine is broken down, and experience gained in the study of disease by the methods practised by the pathologist amplifies and increases experience gained in the wards, so that the student's knowledge of disease becomes an undivided whole.

In practice the teaching of pathology falls into two sections—General or Pure Pathology, and Special or Applied Pathology. General pathology forms the essential introduction not only to special pathology, but to every department of medicine and surgery. It must obviously be commenced immediately after the examination in anatomy and physiology has been passed. The general principles which underlie the degenerations, inflammation, and immunity form the logical sequel of the course in normal physiology, and should be mastered readily enough by a third-year student. The great general processes which play so vast a part in all diseases form the student's introduction to medicine and surgery. General pathology is intelligible to the student who as yet is unfamiliar with clinical work in the wards of the hospital.

It is very different with special or applied pathology. Here we have to deal with changes which occur in certain organs and in

particular diseases. Here it is that co-ordination between the ward, the post-mortem room, and the laboratory becomes essential, for special pathology, medicine, and surgery form one subject. I may perhaps illustrate my meaning by an example. The anatomical and histological changes which constitute the picture of a contracted granular kidney are nothing more or less than fibrosis of the kidney, chronic interstitial inflammation. It is only necessary to apply to the kidney the general principles of chronic inflammation, and all, or nearly all, has been said which appertains to morbid anatomy in the narrower sense. But when we go on, as we always do, to a consideration of the changes in other organs—in the heart and the vessels—to the changes produced in the circulation, to the alterations in the urine and the effects of damage to the excretory mechanism, we are painting a picture not merely of the special pathology of the kidney, but of the sequence of co-ordinated changes which may occur in a living human being and form the essential features of a definite disease. Here, and in almost every other disease, the subject which we call pathology interlocks with that which we call medicine, and it must be so, for the two constitute one whole. Now, however well the pathologist may paint his picture, however well he may be equipped with museum jars and paraffin sections to illustrate the co-ordination of lesions in various organs, it is very hard for a student to understand a disease like chronic interstitial nephritis unless he has studied cases of this disease in the wards of a hospital. The more close the co-ordination in the teaching of special pathology and medicine, the more rapid will be the progress of the student in each. The study of disease in the wards helps the student with his laboratory work just as the learning of medicine or surgery is rendered easier by an understanding of pathology.

This brings us to the important point of the period of time over which the teaching of pathology should extend. While the study of elementary general pathology demands little or no clinical experience, it is, in my opinion, impossible to expect an understanding of special or applied pathology in students who have at the best a most elementary knowledge of medicine and surgery. The pathology course at many medical schools is limited to the three terms (or twelve months) immediately following the examination in anatomy and physiology. This is the time when the student begins his work in the wards and out-patient departments, and the entry into clinical work marks an epoch in the student's career. The orderly courses of the laboratory are exchanged for the casual instruction of the ward. In hospital work a much greater call is made on the individual student's initiative, and his progress depends to a far greater extent on his capacity for teaching himself and seeking out the opportunity for study. Moreover, the novelty of hospital life, with its opportunities for contact

with real patients, and with its numerous adventitious interests, makes an appeal to the student mind which tends to make the rather more familiar routine of work in the pathological laboratory by comparison dull and unattractive. The average student takes a little time to settle down to hospital life, and during this period work suffers. During this period, too, there may be courses in pharmacology and hygiene which must be attended. If we examine the three terms which follow the examination in anatomy and physiology, we find that it is one of the most crowded periods of the course. During these three terms only a limited amount of time—seven to ten hours a week, perhaps—can be spared for pathology, and it is obvious that, with the numerous claims which hospital work makes on his attention, the student can spare but a limited number of hours to the private study of pathology. In my opinion, this fraction of the student's time during the first three terms of hospital work is absolutely inadequate for the study of a subject which should form the keystone of medical science. In practice it is quite impossible to cover the ground in the time. But there are other equally urgent reasons for prolonging the period of the course. Special pathology, from the student's standpoint, is an applied science, and is of importance to him in its relation to medicine and surgery. It is impossible to make the pathology and bacteriology of typhoid fever interesting or even intelligible to a student who has never seen a case of the disease. Typhoid fever is a process, a series of changes affecting every part of the body. The museum jars and the stained sections represent a few important incidents carefully preserved for exact study. Practical experience with actual cases of the disease supplies the missing links of the chain, and the pathological preparations become objects of genuine interest to the student, as they elaborate and explain certain phases of a general process already familiar to him in outline. Is it reasonable to expect an understanding of the pathology of syphilis in a student who has never seen a chancre or a case of general paralysis of the insane? What interest can the student take in the histological differences between a scirrhus and a fibro-adenoma of the breast until he has seen cases illustrating these conditions in the wards and on the operating table? Pathology, if it is to be the useful reality which it ought to be to the student and the graduate, must be learnt in the wards as well as in the post-mortem room and the laboratory. Pathology does not begin when the patient dies. Medicine, surgery, and special pathology form one whole and should be learnt as one subject. If this view is sound, it follows that the examination in pathology comes in some universities far too soon in the course. It is taken before the student has had time or opportunity to discover what pathology is. The course is brought to a close just at the time when the student should be beginning to appreciate its value and understand its intimate relation to the sister arts of diagnosis and

treatment. Instruction in pathology should, in my opinion, extend to the final year of the medical course, and the examination should be taken either as part of the final examination or, at the earliest, six months before. I do not think that this would add to the student's burden, for I think that suitable instruction in special or applied pathology would render easier the task of getting up the clinical subjects of the final examination. I hold that an adequate knowledge of special pathology is essential to an understanding of medicine, surgery, and gynecology. If this is true, instruction in special pathology should be given during the final year, at the time when the student needs it and is in a position to appreciate its value. It does not necessarily follow that the hours devoted to teaching in pathology would be greatly increased. My contention is, that the period during which pathology is studied should be lengthened. Medicine, surgery, gynecology, and pathology form one subject, and should be studied during the same period, and allowed to form one undivided whole.

A Suggestion for a Scheme of Teaching.—Having dealt with the scope and objects of the teaching of pathology, I pass to ways and means, and venture to submit for your consideration the following scheme :—

The entire course is designed to extend over a period of six terms—two academic years—and is arranged to avoid duplication of classes. The first term is devoted to general pathology. The second and third terms are devoted to the special pathology of the blood, the heart and blood-vessels, the respiratory organs, and the alimentary system. During the fourth term of the course there is no systematic instruction in pathology. This term, however, is utilised for the course in general pathology for the students of the following year. In the fifth and six terms the lectures and classes in special pathology are continued, and instruction is given in the diseases of the genito-urinary system, the ductless glands, the central nervous system, and the bones and joints. The students of each year join the special pathology class as soon as they have completed the annual course in general pathology. That is to say, the course in special pathology would be attended by the students of two successive years, and the students of each alternate year would begin the course in special pathology with either the diseases of the blood or the diseases of the genito-urinary system.

General Pathology.—This class would form the introduction to the course in pathology, and would extend over one term. The subjects dealt with would be the elementary principles and practice of bacteriology, the degenerations, inflammation, and the facts and fancies which we are in the habit of grouping under the heading of Immunity. The course would also include the general pathology of tuberculosis and syphilis, and the characters of the more important

tumours. The period of time, one term, may appear short, but I propose to compensate for this by giving, during this term, a liberal allowance of hours to pathology. The number of lectures and hours of work for laboratory classes it would serve no useful purpose to discuss, for these details must rest with the inclination and discretion of the lecturer. I should personally prefer that the class met for a whole day's work on two consecutive days in each week. There would be great advantages in a continuous class from the morning to afternoon, as unfamiliar methods require practice, and the necessary dexterity is often not acquired in the three hours commonly allowed for a practical class. If the class is held on consecutive days the number of methods and experiments which can be practised is considerably increased.

I am, on the whole, inclined to think that the practical course should begin with elementary bacteriology, the general methods of making microscopical preparations of micro-organisms and of separating pure cultures. The general principles of sterilisation by heat and the preparation of culture media should be demonstrated. If time allowed, culture media might be prepared by the class. During this period every effort would be made to demonstrate the methods employed for the collection of material for bacteriological investigation. The students would be encouraged to become familiar with the use of ordinary apparatus, such as the centrifuge and the autoclave, and would be taught to make and use simple accessories, such as spreaders and capillary pipettes. This plan would, I am sure, require more laboratory space than is usually available, but I do not think that either the time or the space would be wasted, for, in my opinion, laboratory courses tend to become too set and formal, and the preparations for the class are often so elaborate that nothing is left which can develop in the student either resourcefulness or dexterity. The general principles of bacteriology would be illustrated by practical work with the staphylococci, streptococci, and B. coli. The tubercle bacillus might be studied at this point, since it is desirable that the student should learn at the earliest possible moment the methods employed for its recognition, and some practice might be allowed in anaerobic methods. The consideration of other varieties of bacteria I should postpone until the student reached the part of the course devoted to special pathology, for, from the point of view of the medical student, bacteriology is not a separate subject, but a part of pathology. A pathogenic bacillus is of importance to the medical student because of the pathological changes and lesions which it produces. The bacillus itself and its cultural properties are of interest in so far as a knowledge of them can be used for diagnostic purposes, or explain the methods by which disease may be cured or its spread prevented. To lecture on the typhoid bacillus in May and on the

changes produced by it in the intestine in November is wanton mutilation. The pathology and bacteriology of typhoid fever form one subject, and should be dealt with at the same period of the course.

After a few elementary lessons in bacteriology the degenerative processes would be studied. This part of the course is an opportunity for introducing practical work in pathological chemistry, if it is thought that the necessary time can be spared. Of the teaching of inflammation I have nothing to say, except that some printed accounts of the subject seem to be extraordinarily elaborate, and the student is rather apt to overlook the essential features in a desperate effort to distinguish between clasmatocytes and polyblasts. Obscure details of this type are, it seems to me, quite out of place in a course for medical students, for whom broad principles and general processes are the first essential, and details only important when they supply the key to the pathology of some particular disease. It is nevertheless true that the long words and obscure passages in a text-book do exercise an extraordinary fascination for the mind of the student.

After or with inflammation comes immunity. The formation of antibodies is just as much the reaction to injury as are the phenomena of inflammation, and the two subjects may profitably be studied together. The teaching of immunity should be based on observations made by the student himself in the class-room. In this part of the subject practical experiments of a simple type are easy for the teacher to arrange and easy for the student to perform. With a little trouble exercises can be set which enable the student to demonstrate to himself the majority of the essential facts, and the necessity for the use of the elaborate symbols, introduced by Ehrlich, is largely obviated. After dealing with fibrosis and repair, tuberculosis and syphilis would be discussed, and the general course would conclude with the pathology of tumours treated in an elementary fashion. I look on the course in general pathology as an introduction to pathology and medicine. In it the student should learn not merely general principles but also the general methods of pathological investigation. The occurrence of pathological material in a hospital is, of necessity, fortuitous, and at the end of the course in general pathology the student should be in a position not merely to profit by instruction in any particular case, but to practise the ordinary methods of investigation for himself. The medical student should be taught to teach himself.

Special Pathology.—It is, in my opinion, essential that the student should learn as one whole subject the special pathology, medicine, and surgery of each organ and each disease. If this plan is to be followed, the course on special pathology must be allowed to extend over the greater part of the period of clinical study. I have already dealt with this question at some length, and I will here only add

that it would be a great advantage if clinical and pathological teaching were so correlated that the lectures on the medicine, surgery, and pathology of any organ could be given in the same week. Co-operation of this intimate kind would certainly be difficult to arrange, and might be found impossible, but if it were possible the results would repay the trouble expended.

The relation between special pathology and medicine, surgery, and gynecology is so intimate that it is obvious that a certain amount of overlapping in the teaching of these subjects must inevitably occur. This overlapping is probably up to a certain point not disadvantageous. Nevertheless it appears to me that a little more might be done in the direction of co-operation between the teachers of various subjects in a medical school. It is seldom, I imagine, that a professor of medicine has any exact idea of the ground covered by his colleague in pathology, and the professor of pathology has as little knowledge of the extent to which pathology is dealt with in the course on systematic surgery. Each teacher within the precincts of his own lecture room defines the limits of his subject precisely as he thinks fit. This is all very well up to a point, and I am sure that we should all resent dictation on the scope and subject-matter of our lectures; but the five years' curriculum is short, and we should all be glad to save time when we could. There are no real frontiers or boundaries between medicine, surgery, and special pathology, and there is certainly much common ground. An occasional round-table conference between the people in a medical school who teach the same class of students might serve a useful purpose, and might save unnecessary repetition. If after such an exchange of views we decided to go our own ways, and to teach on precisely the same lines as before, it would be, all the same, an advantage to know more exactly the lines on which our colleagues taught, the knowledge which we might expect our students to possess, and the kind of instruction which we ought to give to help our students with their work in other departments. There is another way in which the gap between the laboratory and the ward might be bridged, or rather filled up, for there ought to be no gap. Demonstrators in medical, surgical, and gynecological pathology might be appointed. These men, comparatively junior men, would act as demonstrators of pathology in the laboratory, and as demonstrators of medicine, surgery, or gynecology in the wards. One man, for instance, could with advantage hold the posts of demonstrator of pathology and medical registrar. The institution of posts of this kind would do much to stimulate the student's interest in pathology, and, I venture to think, would have no disastrous influence on the teaching of clinical medicine and surgery. Such posts would be, moreover, not without value to their holders.

The business of a department of pathology in a medical school is to

teach the sort of pathology which every medical man ought to know. The closer the co-operation between the hospital and the laboratory, the better for the medical student. The reputation of a medical school has often rested on a tradition of methodical and accurate physical examination handed down from some great teacher. The best way to teach pathology is to utilise to the full the material which every hospital affords. The investigation of every case admitted to the wards should be as full and accurate as it is possible to make it, and the laboratory equipment and staff should be on a scale large enough to make this possible. It is not within the scope of this essay to enlarge on the work of hospital laboratories, but it is obvious that accommodation, equipment, and staff should be adequate for the bacteriological, chemical, and histological investigation of the cases in the wards. The student ought to be able to watch and when possible to assist the pathologist in the investigation of patients with whose conditions he is already familiar. If the cases are examined in the way they ought to be, the student will have opportunity enough of learning the sort of pathology which he ought to learn.

In addition to formal lectures and a systematic laboratory course the most should be made of the opportunities which every hospital affords for demonstrations on the pathology of some particular case. A particularly good case in the post-mortem room, a run of one particular type of tumour from the operating theatre, or the presence of cases illustrating the diseases of the blood in the wards, should be utilised to the full for instruction in pathology. Material from cases which the students have seen in the wards has an interest which is absent from the ordinary specimens given out in class. A great part of the student's instruction in pathology should be based on the material which the hospital from time to time provides. It is of course necessary that there should be the closest possible co-operation between the hospital and the pathology department. From the student's point of view such co-operation cannot be too close. I have often thought that the pathological department should contain a room in which a part of a bench could be allotted to every student for the last two years of his course. To such a place the student could remove any material which he wanted to investigate. Such a scheme would involve much space and some expense, and I do not suppose that all students would make use of such an opportunity, but I do believe the number of students who would make use of such a laboratory would not be small, and the advantage it would be to them would more than justify such an experiment.

Clinical Pathology.—I have dealt so far with the kind of pathology which every medical student must know if he is to acquire an intelligent knowledge of medicine and surgery. I come now to what is ordinarily called clinical pathology, by which I understand the

laboratory methods of diagnosis which are usually practised by a professional pathologist. How much or how little is the student to be taught of these things? Nobody, of course, desires, and nobody expects, that the course should include such training in these methods that the student would be able to carry out the Wassermann reaction, or make a bacterial vaccine. These things are the province of the specialist in pathology. But the student should learn the sort of case in which the services of a trained pathologist will be required; he ought to know how to collect the necessary specimens; he ought to understand the methods which the pathologist uses, their limitations and sources of error, and he ought to be able to interpret the report which the pathologist sends, and assess at neither too low nor too high a value the evidence obtained by laboratory methods. To do this he must go to the laboratory and watch the investigations which are in progress, and carry out, or attempt to carry out, some at least of these methods for himself. Students should for this purpose be attached for a period of three months to the clinical laboratory in the capacity of student assistants. During such a period the student will see enough of the commoner methods to give an idea of what can and what cannot be done. It will not qualify him to act as a professional pathologist any more than the holding of a post as surgical dresser qualifies him to undertake a difficult surgical operation.

The advances in clinical pathology during the last twenty years have been considerable, and all of us hope that the rate of progress in this sort of work will be at least maintained.

If the general practitioner is to be expected to keep up with the advances which take place during the period of his professional career, we must see to it that his training as a student is on modern lines and that he has a knowledge of the lines on which progress is to be expected in the future.

An Honours Course in Pathology.—The medical students of a former generation were often men who had graduated in some other faculty and brought to their medical studies a mind trained by experimental work in natural science or by the logic and philosophy of classical literature. Nowadays such students are the exception, and the first-year medical students of to-day are boys of 16 or 17 years, fresh from a secondary school. Education has undergone a speeding-up process, and in the medical curriculum room has had to be found for a steadily increasing number of special courses. The new subjects have been wedged in, here and there, amid the old, and all the courses have been shortened to meet the necessity of completing the curriculum within five years, and during these five years every day is so crowded with lectures, classes, and practical instruction, that the student can have no leisure for an attempt to co-ordinate and put together the varied information which he receives. The medical curriculum is a system of

cramming, and insufficient time is allowed for digestion. The time has arrived and, I venture to think, is long overdue, when we should sit down to remodel and recast the entire curriculum, consider what is essential and what is not, and to co-ordinate the teaching in all subjects, so that the whole forms a systematic course in medicine in which the connection and mutual interdependence of the various parts shall be obvious not only to the teacher but to the taught The Universities of Oxford and Cambridge still require candidates for the medical degree to graduate first in the school of Natural Science, and in other universities occasional students take a B.Sc. before proceeding to or completing the medical course. The chief advantages rest, not on the extra knowledge but in the additional experience and broader outlook which the student acquires. Problems are probed more deeply, and there is more time to think. The laboratory becomes something more than a class-room, and he learns something of the methods of research. He discovers the literature of the subject, and finds out that the statements of the text-book are not absolute and not final. He learns the art of teaching himself, the most useful thing that a student can learn. The subject chosen for an extra year of study is usually physiology. I think that the time has now arrived when students who are prepared to devote the necessary extra time might be encouraged to take an Honours course in general and experimental pathology. On passing the examination at the end of the course, the candidates would be entitled to a B.Sc. degree. The material for such a course is ready to hand, and it should not prove difficult to arrange a syllabus. The degenerations, the disorders of the circulation, of metabolism, of the ductless glands, the phenomena of infection, fever, inflammation, and immunity, are all admirable subjects for an Honours class. A carefully arranged experimental course and a wide and judicious study of the literature would constitute a training of enormous value to men about to proceed to scientific medicine. The course could be interpolated quite naturally between the third and fourth or between the fourth and fifth years of the medical curriculum.

It is not every student who can afford the time to take such an extended course in general pathology as I have tried to sketch out. Such an Honours course in pathology would be, I know, something of a luxury, something which I should like to see, which I hope to see carried out. But for the moment we are concerned less with luxuries than with absolute necessities, and, as I think, active teaching in pathology is an absolute necessity in a medical school—not merely the pathology of the post-mortem room and of the museum, not merely the pathology of the laboratories, not merely and exclusively the pathology of the wards, but rather pathology as a whole. This whole pathology, as I understand it, is an active and progressive interest in and knowledge of disease, an instinctive impulse to probe the causes, to study in

detail the sequence of changes, to explain the action of preventive and curative measures, and to point the way forward to fresh advances in medical science. Pathology is a general and unspecialised knowledge of disease common to all medical men, graduate and undergraduate alike, general practitioner and consultant.

XII.—ON THE TEACHING OF PATHOLOGICAL ANATOMY, WITH SPECIAL REFERENCE TO CLINICAL MEDICINE.

By Dr. IVY MACKENZIE, Glasgow.

The medical profession, like every other social institution, has its origin and growth in certain human needs. It exists now among races in a primitive form where science is unknown, and the historical basis of modern medicine is traceable to the simple empirical adaptation of means to end in dealing with pains and complaints. There was a rational basis * for the treatment of illness before the days of Morgagni, or of the Hunters, or of Virchow; but with the growth of the biological, physical, and chemical sciences, the centre of interest, especially in research, veered from the phenomena of symptomatology to the underlying anatomical changes associated with various ailments and disabilities. It was gradually recognised that the anatomical basis of disease was of prime importance, not only in classification but also in the interpretation of ailments, and the field of pathology in its various departments is now regarded as the essential basis for the scientific study of medicine. Every other department of the medical curriculum, outside of hospital work, is merely contributory, and clinical work itself loses its value when not associated with an intelligent appreciation of its relation to the principles and practice of pathology. So important a place does pathology now occupy in the medical course that it has become elevated almost into an independent science, and in this way there is for the student a threatened dissociation of pathology from practical medicine, whose interests it ought primarily to subserve.

I have no right to resort to criticism of that department of my own medical school to which I owe so much; that would be an act of disloyalty and ingratitude to a friend and teacher who has devoted his ability and enthusiasm with a perfect singleness of purpose to the interests of the student. If I were to venture any criticism at all it

* The "rational basis" or theory explaining a series of correlated facts is an afterthought on the part of the observer. The mind naturally seeks to justify its interpretation by explanations, however far-fetched, and the difference between the "medical man" of the primitive race and the cultured physician depends on the fact that the latter is able to base his justifications on a more extensive and more complicated system of knowledge.

would be in the light of the suggestion that in some respects too much is done for the student. Knowing, as I do, the elaborate care with which lectures and demonstrations are prepared, how is it that the young graduate is so disappointing in his appreciation of the pathological processes in a clinical case, and what is the nature of this lack of appreciation? His knowledge of pathology is usually out of all proportion to his capacity to apply that knowledge in clinical observation. That may be largely due to the nature of his clinical teaching, but, broadly speaking, it is due to the fact that pathological anatomy and clinical medicine are taught as independent subjects, and as such they remain in his system of knowledge and experience. Question him on pathology in a pathological context and one is surprised at his knowledge; but question him on pathology in a clinical context and one is appalled at his ignorance. This is the crucial point of his failure, and an explanation affords a clue to possible improvement in the teaching of pathology for practical purposes.

My old teacher, Professor Cleland, used to say, "When all scientists are philosophers, and all philosophers are scientists, it will be a very happy world indeed." It might with equal truth be said that when all pathologists are clinicians and all clinicians are pathologists incalculable progress and wisdom will be the fruit of medical experience.

But useful and constructive criticism must begin with conditions as we know them, and suggestions must be confined within the limits of the possible.

Leaving for the moment the clinicians on one side, how is it that the teaching of pathology could be made more practical and more easily incorporated with the clinical ideas of the student, more obviously vital to him as an essential part of his armamentarium in the struggles of diagnosis and treatment.

Take, for example, the growth of one's own knowledge of pathology in relation to medicine. What are the conditions under which the young pathologist, who has already finished with examinations, approaches the subject on his own account and learns to interpret for himself in a more or less independent manner the relation of structure to disease. He begins not with general pathology, or with the pathology of a system, or with a subject in pathology. He begins, as a rule, with a case. The signs and symptoms of the morbid state of some case have been analysed; it has been followed to post-mortem; the organs are examined. His imagination works on the construction of an explanation which will account for the phenomena on a rational basis. The matter is simple; it is the alphabet of pathology; it is the first lesson in the elements of scientific medicine.

It is, for example, a case of long-standing fever with cardiac disease. The essential features recognised clinically were: (1) Protracted, irregular fever, which did not respond to salicylates, although there

was a history of earlier rheumatism. (2) Heart enlargement and valvular murmurs. (3) Increasing weakness and anæmia. (4) Indigestion and dirty tongue. (5) Scanty urine with albumen and blood. (6) Enlargement and tenderness of the liver. (7) Dropsy. (8) Pericarditis late in the course of the disease. (9) Streptococci in the blood.

Post-mortem showed :—

1. Chronic heart disease with recent malignant endocarditis accounting for fever refractory to salicylates.(1)

2. Enlargement and dilatation of the heart. Cicatricial contracture of the mitral and aortic valves. Shaggy, fibrinous deposits on the valves, and small recent ulcers in their area, accounting for cardiac signs.(2)

3. General evidence of sepsis in heart, kidneys (septic infarction), and bone-marrow (red), accounting for increasing weakness and anæmia.(3)

4. Catarrh of stomach, accounting for indigestion.(4)

5. Large, congested kidneys, with hæmorrhage and conspicuous glomeruli, accounting for blood and albumen in the urine.(5)

6. Large, congested liver with distended venules and fat, accounting for large, tender liver and indigestion.(6)

7. Œdema of tissues in the lungs ; fluid in the free somatic cavities ; evidence of failure of peripheral circulation.(7)

8. Pericarditis.(8)

9. Streptococci in cardiac valves.(9)

The process of correlation is simple, and the facts provide a solid basis for the interpretation of the natural history of the disease. Here is a case of chronic cardiac trouble, originating in previous attacks of rheumatism. The natural decline of circulatory efficiency has been interrupted more or less suddenly by weakness, headaches, pains in the joints, and sweatings. Antirheumatic treatment has proved ineffective. Aortic and mitral murmurs are present ; weakness and anæmia increase ; albumen appears in the urine, and later there is blood ; the tongue is dirty, the appetite poor, breathing becomes more difficult ; there is cyanosis of the lips ; anasarca develops, with fluid in the free somatic cavities ; and the liver has become large and tender ; the pulse becomes more rapid ; there is severe pain over the heart, and friction is heard. The blood is examined. Leucocytosis is present, and there is a streptococcal growth. Weakness increases ; the patient dies, and in the light of the post-mortem findings the story is retold.

In the early attacks of rheumatism the aortic valve had become crumpled, and the mitral tendons constricted and shortened. Through a complicated series of local and peripheral adaptations circulation had been maintained in a state of comparatively adequate efficiency till an infective organism gained access, probably from the bowel to the

circulatory stream; found a habitat in the weakening cardiac valves, and a medium of proliferation in the blood. The immunising reaction of the organism being too feeble, the process goes in vicious circles succeeding phases being characterised by progressive weakness, rigors, anæmia, indigestion, albuminuria and hæmaturia, dropsy, breathlessness and cardiac pain. The whole story can be elucidated round the central process of progressive infection, and the conclusions of the successive chapters are depicted in the various organic changes at death. (1) The anæmia had arisen from septic poisoning of the blood, the toxins of streptococci and the débris of their inflammatory productions; and the end-result of the anæmia is shown by the abnormal red bone-marrow. (2) The circulatory weakness is accounted for by a mechanical defect in the heart, the irritation and obstruction of precardial exudate and effusion. The breakdown of the peripheral circulation as shown in œdema and defective elimination is explained by the state of the kidneys, and, in addition to all those factors, the circulation is influenced by the anæmia. (3) Indigestion is accounted for by catarrh of the bowel, due to passive hyperæmia, associated with congestive enlargement of the liver, and perversion of the metabolism due to fatty degeneration of the liver through congestion and defective oxidation; and all these factors accompanied by the effects of defective elimination from the kidneys. (4) The scanty and abnormal urine finds its explanation in congested and inflamed kidneys, the congestion arising from enfeebled circulation, and the inflammation from embolic infection of the glomeruli. (5) Rigors are accounted for by the spreading of septic emboli from the cardiac valves, as evidenced in septic infarction of the kidneys and spleen; and the cardiac pain finds its explanation in pericarditis.

Such, in brief outline, is an account of the natural processes of the disease as reconstructed from the anatomical end-results in the light of the history of the ailment.

But why, you may ask, all these details of a simple case? Simply because these are the details of a story in disease which can be followed and understood by the average student who has a moderate knowledge of anatomy and physiology, and a casual acquaintance with the main clinical phenomena of disease. But this, it may be said, is exactly what is done in post-mortem demonstrations. Personally, I have not seen, either in this or in any other country, a sufficient care devoted to the correlation of clinical phenomena with post-mortem findings in the class-room. In the wards, symptoms and physical signs are considered in detail, but without due reference to the underlying anatomical processes. The confirmation of the diagnosis in a restricted sense by post-mortem examination satisfies most clinicians apart from the unravelling of the details of the process of organic dissolution, and the pathologist is seldom provided with that rational account of the

development of the disease which would enable or encourage him to make a complete story out of the findings. If proof of this were required, it is to be found in the destination of the organs. Take the imaginary case referred to and it would be found that if the heart were preserved it would be placed in a jar alongside of other hearts of a totally different character, and from cases with which our case had practically nothing in common. In another corner of the museum, or in another room, might be found the kidney with an amyloid kidney on one side of it and a large white kidney on the other—in quite an interesting position for the pathologist already versed in the complicated comparisons between the same organs differently affected—but obviously detached from its nosological context, and more or less useless for the elementary study of disease. The nutmeg liver might be stored in still another corner, meaningless so far as its origin and organic associations were concerned. The time which the unfortunate student, who knows little or nothing about pathology, spends with his text-book or his excellent lectures in the average pathological museum reminds me of the unhappy hours I passed among the Greek verbs.

I think I have heard of a new method of teaching foreign tongues, more in consonance with the evolutionary idea of the growth of speech and language than that in practice some years ago; a method whereby the pupil is first taught to practise the simplest forms of expression and interpretation, and only later proceeds to the study of the grammar and syntax which embody the principles of the language. In pathology an attempt is made to force the student to make a speech before he can lisp; he is expected to understand the language before he can interpret the meaning of simple sentences. My criticism of the ordinary pathological course is that it is too advanced for the student; that he begins at the wrong end of the subject; that his lectures and museum would provide an admirable sequel to a more elementary education on the subject, in which he should be instructed in following the correlated clinical phenomena and anatomical changes in straightforward, typical cases, and in which the anatomical material should be arranged in such a manner as to provide him with a complete picture of the end-results of pathological processes in organic relation to each other. In addition to this the organs from interesting cases should be preserved temporarily; accurate histories and clinical findings should be prepared, and the specimens should be demonstrated twice or three times to students and also to their clinical teachers. The specimens might be discarded in two or three weeks to make room for others. In this way the student and clinical teacher would acquire the habit in the ward of interpreting their cases from an anatomical standpoint, and of anticipating in an intelligent manner the prognosis or fate of the case.

In turning from the course itself to the nature of the teaching there are some points worthy of consideration.

I remember a time, and that can only be a few years ago, when pathologists regarded the field of pathological anatomy as cultivated and reaped to the last inch. In every condition which had come within the nomenclature of disease, changes degenerative, proliferative, and transformative had been described *ad nauseam.* Perhaps it was that the discoveries in bacteriology provided a fresh incentive to enter on new and more promising enterprises. But bacteriology has had its disappointments, and while its contributions to the knowledge of disease in general have been enormous, apart from its importance in public health and social hygiene, it has not fulfilled in its influence on everyday medicine, the promises of twenty years ago. With something resembling the appearance of despair recent investigators have been turning to chemistry, hoping, no doubt, to find there a solace for their hopes which have been frustrated in other directions. Not that I would say a word in discouragement of research in pathological chemistry, but such research should not be regarded as a last resort in attempting to unravel problems of disease, and the result should not be so construed as to distract the attention of the student from the primary and fundamental importance of pathological anatomy. Anatomy has been, and will continue to be, the essential basis for the study of disease, and one would imagine that there must be something in the point of view of the pathologists which has produced this feeling of lassitude and monotony which has sought relief in bacteriology and chemistry. I would suggest that stagnation has arisen in the interest in pathological anatomy for the simple reason that for many years the best pathologists have pursued it as a cult, instead of keeping their minds open to the demands and necessities of practical medicine. The descriptions of the histological features of diseased organs had become an end in itself; the fixation, mordanting, and staining of tissues had become a fine art; and the descriptions of the microscopic appearance of diseased tissues had reached a point where, in most cases, they had no bearing whatever on diseased organisms so far as the interpretation of illness was concerned. It was tacitly assumed by many teachers and by most students that more could be seen through $\frac{1}{6}$ than through $\frac{1}{4}$, and that through $\frac{1}{12}$ oil immersion lens there might be found a still more reliable avenue to an explanation of the hidden processes of disease. The pathological journals, especially on the Continent, were composed of long articles with beautiful illustrations provided from sources of great industry and considerable ingenuity, but tending nowhere. It was little wonder then that the pathological anatomist turned to the more promising fields of bacteriology and chemistry.

But this diversion was due to a mistaken method in the province

of anatomy and a limited conception of its possibilities. The mistake has arisen by an undue concentration of attention on the end-results of disease, on the disorganised wreckage as it is found on the post-mortem table. If part of the care and speculative intelligence devoted to descriptions had been directed to a reconstruction of the processes which lead to final dissolution, the results would have been different. It is not only that co-operation between the pathologist and the clinician has been deficient, but on his own account the pathologist has been absorbed by the interest of the morbid state to the neglect of the morbid process. Descriptive pathology, and of course histological pathology, has made enormous advances since the days of the Hunters, but there has been no corresponding advance in the functional pathology which constituted their immortal legacy to medical science.

In recent years the teaching of normal anatomy has been revolutionised in this country by Keith and Elliot Smith. Their influence has probably permeated every medical school and must be reflected in the more vital and more practical conceptions which the students now receive in their anatomical teachings. They have discarded the "dry bones" anatomy of facets, grooves, minute distributions of nerves and meaningless relations, for an anatomy where structures and relations are interpreted in the light of function. The pathologist and the clinician have unique opportunities for furthering the progress of this aspect of medical science, and the work which has been done on the blood by Ehrlich, Muir, and Browning, on the heart by Mackenzie, on the arteries by Allbutt, on the liver by Rolleston, on the kidneys by Bradford and Herringham, and on bone by Macewen should be carried on in the observations of disease in these and in other organs. Medical science requires, and the student ought to have, a pathology of the living, instead of a description of the dead.

Take, for example, the pathology of rickets as usually presented to the student. His attention is directed almost exclusively to thickenings of the bones at the epiphyseal lines, to abnormal vascularisation of the irregularly growing cartilage, to the formation of osteoid tissue, to processes of decalcification, absorption of old bone, and to irregular deposits of salts in the areas of new bone formation. It may be suggested to the student that the condition is due to an organism not yet discovered, or to some perversion of internal secretion, or to abnormality of metabolism in special relation to the calcium salts; to some abnormality in the blood; to intestinal or auto-intoxication, the last resort of those who, having discarded the dispensation of Providence, must have an explanation of some sort. But whether or not he make reference to these vague suggestions he should attract the attention of the student in two directions: backwards in the course of events to the genesis of the rachitic disorder, to something as big and obvious as a

three-storeyed tenement with a single apartment on the top flat in which are crowded in a dark, fusty atmosphere, a father and mother and six children; and he should look forward to the sequence of events in which the bone transformations are but links in the chain; to the loss of elasticity in the thoracic walls, with possibly atelectasis and broncho-pneumonia, especially in the event of measles or whooping-cough; to the atonic state of the abdominal muscles with intestinal disorders; to the stunted physical and mental growth, which leave the victim of rickets in so many cases a moral and economic incubus on society. It is, no doubt, a matter of much academic interest to discover whether rickets may be due to an infection whose toxins poison the growing bone, or whether the perverted metabolism, due to obscure chemical causes, brings about the osseous change, or whether the lesion is associated with some vital and subtle abnormality in the actual growth of young bone as such; in other words, whether the cause is bacterial, chemical, or vital, or a combination of some or all of these factors—these, I say, may be considered of great academic interest—but the important thing for the student to know is that this condition in its origin is associated with well-defined factors in life, which he may be able to influence in the course of his work as a medical practitioner; and he should have the authority of the pathologist for believing that once the rachitic condition has supervened the morbid course of the disease may be so directed or deviated as to avoid the fatal complications which it carries so often in its train.

Perhaps even more suggestive, from the point of view of functional pathology, is the condition known anatomically as arteriosclerosis. It is described to the student of pathology in comparison and in contrast with atheroma—a form of arterial degeneration with which it has absolutely nothing in common, either as an illness or as a morbid state or process. But this comparison and contrast rivets the attention of the student on certain facts which tend to distract his mind from a serviceable appreciation of the important features of the process underlying arteriosclerosis as a disease. He knows, for example, that in arteriosclerosis the muscular tissues of the arteries and arterioles are fibrosed in their whole length and circumference, whereas in atheroma the degeneration is patchy and at first in close proximity to the intima. He knows that arteriosclerosis is associated with sclerotic kidneys and enlarged heart, whereas this is not the case in atheroma. In the wards, if the conditions are differentiated at all, he hears arteriosclerosis referred to as a form of chronic Bright's disease, or as a cardio-renal case. He may be told that clinically there are certain characteristic retinal changes, that the blood-pressure is abnormally high, that the heart is enlarged, and that the kidneys are in a state of fibrotic degeneration; but neither in the wards nor in the post-mortem room is he presented, as a rule, with an account of the morbid process,

which, lasting through years, culminates in the arterial fibrosis which accounts for the final state in which the patient succumbs. Yet, however obscure the vital or chemical factors which determined its origin and progress, there can be little doubt about the essential nature of the origin and progress, and there are few diseases which present such easily recognised functional derangements of an anatomical character leading to such obviously inevitable conclusions. It requires no great knowledge or imaginative power on the part of the student to understand that the disease begins with what is probably a more or less generalised increase in the arterial tonus, depending upon some irregularity in the vasomotor system, probably associated in turn with perversion of the internal secretions. The increased arterial tonus is met by an enhanced effort on the part of the heart to meet the demands of the body tissue for nutriment. For a varying time the disease may be in progress without giving rise to illness, but sooner or later, when once the process has been well established, the enlargement of the heart does not suffice to overcome the peripheral obstacles. Among the earliest symptoms may be those referable to deficient blood-supply to the alimentary tract (for in most cases the mesenteric vessels are markedly involved); indigestion, flatulence, and headaches supervene. The kidneys, with their double capillary system, find difficulty in exercising their function of efficient elimination. The heart labours, and thumping noises are felt in the head, and palpitation is occasionally experienced. The heart may as yet be only slightly enlarged; there may be no albuminuria, but the blood-pressure is high. This may be the stage at which the unstriped muscle of the arteries is hypertrophied but not yet fibrosed. This is the stage at which therapeutic interference might be useful. But hypertrophy of the arterial muscle is followed by fibrosis; the resilience of the walls becomes diminished and the embargo on the heart is correspondingly increased. Further cardiac enlargement is evidenced in increase in blood-pressure in the middle-sized arteries; the heart fails to send sufficient nutriment to the tissues; retinal changes occur; the kidneys become fibrosed through the inability of the heart to force the blood through the double capillary system; the patient complains of cold extremities, for the blood, still in high pressure in the large arteries, does not reach its destination of metabolism, and there is usually an accumulation of fat as a result of deficient oxidation. The defective nutrition leads to a general lowering of vitality, and genuine nephritis or pericarditis may be the result. Œdema may occur as a result of failure of the peripheral circulation—and this may happen without true cardiac failure, for the heart may be twice or three times the normal size and the valves remain competent and the muscular tonus good. The cerebral and coronary arteries may not be involved in the process, although cerebral hæmorrhage may produce a fatal issue early in the

disease as a result of high pressure in vessels which may eventually be atheromatous.

Such an account of this common ailment from the clinical and pathological standpoint could be easily grasped by the student, would excite an interest in the relation of pathological processes to end-results, and might be of invaluable service to him in his practical outlook.

There is still another aspect of pathology which should be constantly kept in view. On its positive side the main effort of pathological research is directed to the establishing of a nexus between processes of disease as exemplified in the reactions of abnormal function and the complaint of the patient. But the phenomena of complaint are far from being a perfect reflection of the processes of disordered function in the narrower biological sense. Disease may run a prolonged course, as in the case of chronic nephritis, cardiac degeneration, and many infections, before it reveals itself through the consciousness of the patient. Weeks or months, or even years may elapse before a well-established process of anatomical degeneration is manifested in illness; and the particular time at which such degeneration produces a disturbance of the equilibrium between the patient and his conditions depends not only on the stage of development of the disease but also on the susceptibility of the patient to an appreciation of disordered function. The subject of cardiac valvular disease, for example, may be unaware of his affliction until the occurrence of an emotional shock which lowers the whole tone of his nervous system, when he becomes aware for the first time of an organic disability which has been present for years, although never revealing itself so long as he enjoyed comparatively good health in other respects. It cannot be too strongly emphasised that when a patient becomes ill it is the whole patient who suffers and that the primary fact in his suffering is a disturbance of the equable accommodation to his surrounding conditions; and that every complaint that he makes must first reveal itself through his consciousness, whether it be palpitation, pleuritic pain, discomfort after food, paralysis of the hand, or defective vision. Each of these complaints must first pass through the medium of the brain before it becomes a complaint. It is, of course, in the first place the duty of the clinician to emphasise this to the student; but the teaching of pathology is, as a rule, so categorical in its methods that the student is apt to be misled, or at least disappointed in the later stages of his studies, if it be not emphasised early in his course that pathology has to do primarily and directly with disease and only secondarily and by inference with complaints.

And one may go a stage further than this and point out that there are numerous diseases and numerous complaints and organic disorders for which no well-defined anatomical, bacteriological, or chemical

basis can be determined. These are functional disorders, often associated with what are apparently disturbances of the nervous system; there may or may not be an emotional or psychic factor in their incidence, and the site of the disturbance may be practically any organ or any system in the body, and in some cases more than one organ or system may be involved. One of their chief characteristics is the suddenness with which they disappear without leaving any trace of disability, even in cases where the organic disorder has been very profound, as judged by the degree of disability. An explanation of their nature is to be looked for in all probability in those vital forces which conserve the unity and vitality of the organism in its various relations. Organic changes and chemical or physical abnormalities are to be looked on rather as an expression than as a cause of the disorder. It is not to be expected that the student should be introduced to a serious and protracted study of this the most difficult side of medicine, but he should be warned of its existence from the very commencement of his clinical studies. No course of pathology is complete which does not include this warning and which does not, in that event, make it clear to the student that however many of the diseases and ailments with which he may have to deal can be explained on an anatomical, bacteriological, or chemical basis, there are many diseases and many ailments which cannot be interpreted on the basis of pathological teaching as commonly understood.

My contention then in substance is, that the teacher of pathology should have constantly in view—(1) the student; (2) the subject of pathology as it appeals to the student; and (3) the relation of pathology to the rest of the medical curriculum.

1. As regards the student, the teacher should recognise that he can be led into the kingdom of pathology as into the kingdom of truth only in the spirit of a child. He is capable of understanding only the simplest phenomena and has as yet no capacity for grasping the essential features of the principles of a science whose elementary facts have not yet been presented to his observation. In this context I cannot do better than quote the remark of Dr. Crouthers, a distinguished American preacher. "We sometimes think of the teacher as a lawgiver and of the learner as one who docilely regards what is graciously given. But the law to be understood and obeyed in education is the law of the learner's mind and not that of the teacher."

2. The subject should be taught so as to present the student with a clear conception of the nature of diseased processes as contrasted and compared with the nature of end-results; and no opportunity should be lost of demonstrating the relationship between organic changes and the clinical phenomena of disease; and also the negative side of pathology should be emphasised where opportunity occurs: namely, that aspect of the study of disease wherein it may be clearly shown

that the complaint from which the patient suffers is not necessarily the result of a recognisable anatomical change as a causal factor, but merely a transient disorder of a functional character simulating disease due to irreparable organic changes.

3. The teacher must bear in mind the relation of the subject to the rest of the medical curriculum and must himself be in the closest co-operation possible with those who are engaged in the interpretation of clinical phenomena; and if he is to secure for the subject of pathology its proper position from the point of view of practical medicine in the curriculum he may do so in the hours which are devoted with such futility to some of the other subjects. In this context one is reminded of the waste of time and nervous energy devoted to the memorising of insignificant and meaningless details in anatomy; and to the weary hours spent in listening to lectures in midwifery which deal, after all, with the theory of a simple physiological process and its variations and anomalies.

It seems impossible that there can be any far-reaching reform in the teaching of pathology which does not involve other subjects in the curriculum, and it will be difficult to secure any such reform until it is recognised that in the Scottish universities at least, medicine is still taught to a large extent by the methods which have been inherited in the history of the universities from the teachers of theology and metaphysics. These subjects it may be possible to teach from a chair, but pathology and medicine can be taught only in conjunction and in the laboratory and at the bedside.

XIII.—PATHOLOGY IN GENERAL PRACTICE.

By JAMES S. EDWARDS, M.B., Ch.B., Bridge of Earn, Pathologist, Perth Royal Infirmary.

I PROPOSE, as shortly as possible, to discuss the present position of pathology as it affects the general practitioner. And at the outset—speaking as one who has been able to combine with general practice a certain amount of laboratory work—I find myself bound to admit that the outlook is far from encouraging.

To the average practitioner the opportunities for pathological work are extremely limited. They are limited, in the first place, by the necessity of purchasing and maintaining a certain amount of rather expensive apparatus. The most willing workman can do nothing without tools, and the upkeep, even of a small laboratory, is an expensive hobby. His opportunities are limited, in the second place, by the totally inadequate payment for private laboratory work. Unless he is prepared to balance—against a great expenditure of time and energy—his own increased knowledge and enthusiasm, he must expect to face a dead loss. These reasons may appear sordid; but, after all, most of

us are under the necessity of earning a livelihood. And it is not to be expected that many will care to take up as a hobby a branch of medicine so financially unremunerative as clinical pathology. It must be remembered that I am speaking now of the average general practitioner—not attached to any hospital—and relying for clinical material entirely on the cases occurring in his own practice.

Very different is the case of the practitioner attached even to a provincial hospital, and taking up pathology as a serious specialty. Here the opportunities—except in the matter of time—are unlimited. The point I wish to emphasise meantime is that it does not, and never can, pay the general practitioner to do his own laboratory work.

Lastly, the opportunities for pathology in general practice are limited by that great uneducated public to whom the very word "post-mortem" is suggestive either of morbid curiosity or diagnostic failure. And this, I think, is the most serious limitation of all. Nothing is more discouraging to accurate diagnosis, to careful clinical study, than the certainty that one's results can neither be confirmed nor confuted. We learn from our failures, our mistakes and uncertainties, but only in so far as we can eventually confirm them. The mysteries that remain for ever unsolved leave us only annoyed and with less clinical enthusiasm for similar cases in the future. Why are surgical cases so much more interesting than medical? The average practitioner will go miles to see his patient operated on. If there is some element of doubt in the diagnosis, he will give up almost anything to be present at the operation. And not merely to see a display of technical skill on the part of his favourite surgeon. Far more to satisfy himself, to see with his own eyes the actual morbid condition he has already visualised mentally. Surgical pathology is a reality—a visible and tangible reality—not a mere memory of text-book descriptions. Were medical pathology the same, we should gain in self-confidence what we might lose in self-complacency. Pathology makes for precision; it deals with facts. And the greater our power of visualising the underlying pathologic process, the closer we come to a proper concept of disease. We are too apt to be content with symptoms—to diagnose, to treat, even to certify symptoms. We lose sight of the wood for the trees. Losing all hope of eventual certainty, we become content with slipshod methods—incomplete examination, doubtful diagnosis, and symptomatic treatment. Our knowledge of morbid anatomy atrophies from disuse, and pathology ceases to affect the general practitioner as soon, and as completely, as the general practitioner ceases to affect pathology.

This may be a depressing picture, but it does, I think, truly represent the position of pathology in general practice to-day. Now, if the future of medicine is, as it must necessarily be, to a great extent, dependent on pathologic research, surely it is of the utmost importance that the general practitioner should be encouraged to maintain his

interest in pathology. In the great majority of cases he cannot, for the reasons I have given, be expected to do the actual work for himself. But if he is sufficiently interested, sufficiently encouraged, he can and will supply the material.

Here is a point I would like to emphasise. The only material that is really valuable, from the point of view of morbid anatomy, is the case that has already undergone thorough clinical investigation. And, as Mackenzie has pointed out, it is only in general practice that we can follow disease from its origin. The specialist, the hospital physician, the pathologist, all of these see disease largely in its advanced stage or its termination. It is to the general practitioner we must look for further research into the earliest symptoms, the gradually progressive course. But the fullest and most accurate clinical study is of little value without confirmation. It is here that pathology must come forward to take its part. And by pathology I mean every branch of the subject, every test of the clinical laboratory, from a simple blood count to a full post-mortem examination. If the general practitioner cannot supply these for himself, they must be provided for him. They ought to be provided for him. To some extent they are, but how little they are taken advantage of. The reason, I think, is not far to seek. Before he is likely to take advantage of the opportunities, some of which are, all of which I hope will eventually be, open to him, the general practitioner must *himself* have had a thorough training in pathology. He must *himself* take an active interest in morbid anatomy, even at second hand. If you will allow me a few minutes, I should like to put before you a short constructive policy which, I think, would make for a better appreciation of pathology in general practice. And first let me state three axioms:—

1. Every graduate should have a thorough training in pathology, both theoretical and practical. This should be sufficient to allow him, should he find the opportunity, to carry out for himself not only routine laboratory work but also research. More important still (for pathologists can always receive special post-graduate training), it must be sufficient to impress on him for all time the necessity of taking advantage of the opportunities which we hope will eventually be offered.

2. Every general practitioner should have the right to a laboratory report on any pathologic material. And this at no expense to himself or his patient. Further, this should certainly include the right to the services of a competent pathologist to perform a post-mortem examination in any case of interest. From personal experience I am sure that the practitioner would more easily obtain permission for such examinations had he not himself to take an active part in them.

3. Every provincial hospital should be provided with a fully equipped laboratory and a whole-time pathologist. I say *whole time*

advisedly, for I am sure that a part-time man can do justice neither to his laboratory nor his practice, neither to his colleagues nor to himself. Further, unless some time is to be given for original research, the pathologist is bound to degenerate into a mere mechanic.

There may be some strong arguments in favour of centralising all laboratory work round the teaching schools. Nevertheless, I am quite certain that the only method of bringing pathology into active touch with the general practitioner is through the medium of the local hospital. All such local laboratories must, of course, be in intimate touch with the pathology department of some university, so that the more difficult examinations may be submitted for expert opinion.

The last two propositions, I am aware, can only take effect under some scheme of State Medical Service. Therefore we need not discuss them further meantime, except to point out that under any scheme of State control it is essential that pathology should receive adequate recognition, and that local laboratories should be recognised as essential.

It remains only for us to consider how the student can best obtain a suitable training in that subject which is so essential not only to his own knowledge of medicine, but to the whole future of medicine itself.

Here I must apologise for venturing an opinion at all, for I am now far out of date. During the last ten years the teaching of pathology has improved so much, at least in Edinburgh, that there is comparatively little one can suggest in the way of improvement. My information regarding the present teaching is, of course, second-hand, gathered from recent graduates, clinical assistants, and residents at our Infirmary. They are certainly much better grounded than we were ten years ago, but their education still, I venture to suggest, bears the same taint. They are academic rather than practical. In every case they know (theoretically) what the laboratory findings ought to be. In most cases they admit to having been shown the procedure perhaps once. But almost invariably they show the same hesitation in how to proceed, the same complete want of confidence in their methods, and consequently in their results. This want of confidence has struck me more than anything else about their practical training. The student never seems to get sufficient practice with the methods to become thoroughly familiarised. And it is only familiarity with the technique that breeds a proper contempt for the possibility of failure.

The cause, I think, may possibly lie in the overlapping of the different practical classes. In histology the student is taught practical histological methods. Next year he is again taught the same methods —with considerable variations—in the class of practical pathology. Finally, he does the work for himself (which, of course, is the only possible way to learn) in that excellent class, instituted since my time —the class of morbid anatomy. His practical bacteriological methods

are, I understand, merely suggested in the class of bacteriology, though he can get a full training in the advanced class, which is not, however, compulsory. His other practical methods—blood counting, examination of blood films, differential counts, blood-pressure readings, and polygraph tracings—he may, or may not, pick up for himself. I understand they are taught in the tutorial classes of clinical medicine. You may say that this is not pathology. But I venture to assert that there is often more practical pathology in a polygraph tracing than in a whole post-mortem examination.

Further, these are the only branches of pathology on which the general practitioner is likely to have the opportunity of study in after-life. The only pathological material constantly to his hand will be the blood and the various exudates. The general practitioner, provided with a serviceable microscope and an adequate training in the morphology of the blood-cells, is never likely to lose his interest in pathology.

To come to details. I would like to offer the following ideas :—

1. That practical classes should be restricted to practical work, and only to such work as is likely to be of value to the student in later life. There is no place more unsuited for imparting theoretic knowledge than a practical class.

2. That the classes of histology and practical pathology should be combined into a class of histo-pathology, in every case the normal being compared and contrasted with the abnormal. No practical methods should be taught in this class.

3. That practical histological methods should be taught in the class of morbid anatomy, this class being extended if necessary.

4. That bacteriology should be a lecture class, and compulsory.

5. That there should be a compulsory class in laboratory technique. In this the student should be taught how to make and use capillary pipettes, using the air-bubble index, and to handle minute quantities of serum, etc. He should be taught not once, but many times, how to put up sedimentation tests, to plate out specimens of urine, sputum, etc., to pick off and examine the colonies for himself, and to make simple vaccines.

That the tutorial classes in clinical medicine should be made actually, not theoretically, compulsory, and no student should get a certificate till he is thoroughly conversant with all methods of blood examination, sphygmomanometry, and the interpretation of cardiograph tracings.

Lastly, every possible means should be taken to correlate the teaching of pathology with that of clinical medicine. It should be compulsory for the clinical clerk in every case in which a post-mortem is obtained to attend the examination and to demonstrate the specimens at the next clinique. The morbid anatomy of cases which have not

previously been examined clinically can never be of the same value as teaching material. It is the spirit of research that must be fostered, the ambition to follow our cases to their ultimate conclusion. Research is the true spirit of medicine, and it is only by stimulating this spirit in the work of the student that we can keep it alive in the work of the general practitioner.

XIV.—THE TEACHING OF PATHOLOGY.

By Professor LORRAIN SMITH.

The aim which is before the teacher of pathology is to train the student to interpret the process of disease by a study of the changes in the organs and tissues of the body. In doing this he will inevitably find himself compelled to deal with problems which are primarily the matter of the physician or surgeon; but his own question is clear enough, and we need not spend much effort in trying to make a perfect delimitation of the pathologist's territory.

The science has developed from systematic medicine and surgery, and in its first form it was the presentation of the history of disease, so far as it is revealed by structural changes and new formations that arise in the body, which has to adapt itself to pathological conditions.

A section on pathology has still its place in each chapter of the text-books of medicine and surgery, and one reason for this is that after study of the structural changes we are able to visualise the process of disease. If the student has once clearly and firmly imprinted on his mind the picture or impression of these modifications of structure, his knowledge of the disease will have a vividness and reality which is hardly to be obtained in any other way. On this account the study of pathology has been greatly valued by both teachers and taught.

In the scientific advances of modern medicine pathology has taken a leading part. It has extended its territory, and has come to be the science of disease in the sense that it includes the investigation of disease by all the experimental methods of biology, *e.g.* methods of histology, of chemistry, of physics; in fact, by all the methods which science has been able to apply to the investigation of the life of the organism.

In the advance which pathology has made it has come more and more near to the problems of the clinician. This is natural, for in the development of medical science it is clear that pathology and medicine must come ultimately to be one. Indeed it would appear as if already certain forms of diagnosis are never to be taken from the pathological laboratory, and certain forms of treatment are left in the hands of the pathologist.

The teaching of pathology must keep pace with the all-round pro-

gress of the science, and it will clear up the inquiry which the Club is making into this branch of the subject if I state shortly the method of teaching which we have now adopted in Edinburgh.

The general purpose has been to bring the teaching of pathology and bacteriology into the closest possible relation to clinical teaching. The student begins the study of systematic medicine about the same time as he begins to work at pathology, and the two courses are arranged to correspond with each other. The circulatory system is taken up at the beginning of each course; this is followed in each by a study of the respiratory system, and then of the digestive system, and so on. It is less easy to co-ordinate the clinical courses, but I am convinced we will find it worth while to do more than we have attempted hitherto.

In the pathology department the course consists of about sixty lectures on systematic pathology, twenty lectures on bacteriology, ten practical meetings for morbid histology, ten practical meetings for bacteriology. In this way the hundred meetings of the class are utilised. These are supplemented by an indefinite number of demonstrations in the various branches of the subject. There is also the class in practical pathology, in which the student spends six hours a week for a term, and gets about one gross of sections illustrating the commoner pathological conditions, but it is really a course of morbid histology of an abstract and antiquated type.

There is finally, the most important of all, a course of morbid anatomy in the Infirmary. In this the student is introduced to pathological investigation. He is required to work out a report on the pathology of six cases—three in each of two terms. He is supplied with the details of the clinical record; he makes notes of the post-mortem examination, and gives a description of the appearance of the affected organs in each case. He is also required to investigate these tissues microscopically. After this he writes a summary or review dealing with all the points of pathological interest which the study of the case reveals. In short, he is required to write a report on the case as complete as he can make it. It takes usually three weeks to accomplish this. At first a great deal of personal teaching is required, but by the time the third case has been done the student has made great progress in the art of writing reports. Having written his report, he hands it in along with the slides he has prepared. On the report and the slides criticisms are made by the staff, and values in marks are given for each report; these values are included in the total which determines the class honours.

The result of this method is that the student grasps the unity of disease from the first. It is the whole case he has to consider and explain, and the idea of development of disease and sequence of events and inter-relation of various systems, so far as it can be seen in the study of pathological changes, is clearly brought before him. It is

far and away the most interesting form of pathology; the student discovers this at once, and his interest is as keen as any teacher could desire. He learns that, in order to understand disease, he must trace it from its earliest to its last stages. In doing this he finds it necessary to guide himself by using all the data there are available. The symptoms, from the earliest to the latest, are carefully noted. One of our students last year, on whose imagination the history of a case of ulcerative endocarditis had taken hold, remarked that "the stream of mischief had its visible source in highlands of the patient's past sixteen years ago."

The progress of the disease is followed in a study of the patient's medical history, and the problem takes the form of trying to discover in the tissues the structural changes which correspond to the successive stages of the development of the illness.

Disease, therefore, becomes a history and a unity in his mind, and he becomes alert to discover indications of any kind which throw light on the process. In short, pathology taught in this manner serves its fundamental purpose of awakening the student's mind to the meaning of disease, and aids him in the difficult task of interpreting cases in the wards.

This winter's programme, part of which has been carreid out, is as follows:—

1. A case of infective endocarditis, with the usual complications.

2. A case of pulmonary tuberculosis in which there was tuberculous broncho-pneumonia, with a cavity in the apex; diffused tubercle of a miliary type in lung, liver, spleen, kidney, and meninges, etc.

3. A case of pernicious anæmia, with well-marked changes in bone-marrow, spleen, liver, kidney, and heart.

4. A case of myeloid leukæmia, with changes in bone-marrow and various viscera.

5. A case of chronic interstitial nephritis, with arteriosclerosis and cerebral hæmorrhage.

6. A case of atrophic cirrhosis of the liver, with malignant growth.

We divide the class into groups of five or six members, who work together. Unlimited debate with each other and with the teachers goes on. The student is encouraged to get help from any quarter in which he can find it. The one condition of the work is that the report is his own composition.

I may add that the teaching museum is essentially a collection of cases; all the affected organs from a given case are mounted together, and for each there is a type-written fasciculus giving the clinical history, the post-mortem report, a description of the microscopic findings, and finally a discussion of what the student should learn from the case.

It may seem to the Club that the course has been taken to the limit of practical teaching, but I do not think that has even yet been

reached. So convinced am I of the value of teaching by means of complete cases and case studies that I wish to see the pathology course planned out on this basis. As yet we have still the old system in the background. We have broken it up in two ways. Firstly, since the Chair of Bacteriology was established there have been two teachers, and that gives the student a helpful and stimulating change of diet, with, incidentally, a peculiar joy in trying to find diversity of teaching. In the second place, we have a number of days for practical work in practical bacteriology throughout the session, and this, again, lightens the burden of lectures.

I would, however, like to see a course planned somewhat as follows:—The students might commence pathology in the summer term, three months before they begin work in the wards. They would in this way have the advantage of an introduction to pathology a little in advance of their clinical work, while the greater part of their pathology course would be given along with the teaching of medicine. I would replace the morbid histology course in summer and the lecture course in winter by a combined course of lectures and practical work, the practical work being primarily the investigation of cases. I would begin the course with a few lectures on inflammation, but as soon as possible I would adjourn the lecture class to study, say, a case of infective endocarditis, with its thrombi and foci of infection and inflammation in lungs, spleen, kidney, brain, etc. When the student had seen all the reactions of inflammation in vascular and avascular tissues, and had seen the toxic necrosis, the phagocytosis in the spleen and glands, the leucocytosis of the blood and the activity of the marrow, the degenerations in the heart and glands and so forth, then I should give him lectures on the subject and deal with any points that had not been included. At the same time he would begin the course of bacteriology, and he would have, in the first place, to take up the study of bacteria of septic infection.

The student would then take up the study of arteriosclerosis and myocarditis in another case with aneurysm, etc. This might be supplemented by one or two lectures on diseases of blood-vessels. We would then pass to the study of the respiratory system. Pneumonia in its two forms—lobar and lobular—might be studied in two cases for the first report; pulmonary tuberculosis with extensions, such as intestinal ulcerations; general tuberculosis, etc., with degenerative destruction of the tissues—amyloid, hyaline, fatty—in the various organs. Add to this a dust disease, with dilated right heart and chronic venous congestion of the viscera, and the student would have so much real knowledge of the lungs that it would be appropriate to give him a few systematic lectures on the pathology of the diseases of the respiratory system. He would at the same time continue the course of bacteriology in relation to pneumonia and tuberculosis.

It is unnecessary to continue filling in further details; the general principle is clear. We should teach pathology from the study of actual cases, in place of attempting to make the study of books or systematic lectures the basis, with a certain amount of practical work added. We require to apply what is agreed to be a truer conception of scientific teaching. The old course of systematic lectures has had its day as a method of teaching pathology. There is no subject in the medical course which is so easily taught in a practical fashion as pathology. There is no lack of material, and in teaching by case reports in the manner I have sketched the student is introduced to the method of inquiry and investigation which he is expected to continue in his clinical studies. Nor do I find it difficult to rouse in his mind the interest which a case should present as a subject of research. It is unwise, I think, to ask students generally to take up research while they are undergraduates, but it is disastrous to fail to create an interest in research which will bring them back to post-graduate study when the opportunity offers.

Should systematic lectures be dethroned from the chief position, I think it would be necessary to adopt some method of issuing to the class a printed statement which would form a substitute for lecture notes. Were this done, I think only benefit would result from giving systematic lectures a subordinate position in the course.

I have said that the attempt has been to bring pathology into close relation to clinical work. While we are doing this, we would claim that by co-ordination of methods the value of the teaching in pathology should be duly conserved in the later clinical studies. This should be done by including in the clinical reports which students are trained to make in the wards a complete statement of the pathology of the cases. This can be done in two ways:

1. The clinical case report should include a definite statement of the findings by the methods of clinical pathology and their relation to the development of the disease.

2. Those cases which came to be examined post-mortem should be worked out in the manner I have indicated above, and a full statement of the post-mortem findings should be included in the report, and with this the student should furnish a summary and review of the case to make clear to his clinical teacher that he has grasped the whole case.

In this way we would go far to secure the co-ordination between pathology and medicine which we all desire.

[Dr. J. W. Dawson described in fuller detail the work done in the class of morbid anatomy, and read some reports that had been drawn up by students. He also demonstrated a few of the "cases" from the teaching museum.]

XV.—THE PLACE OF BACTERIOLOGY IN THE ORDINARY MEDICAL CURRICULUM.

By Professor RITCHIE.

I have to deal with the subject of the place of bacteriology in the ordinary medical curriculum. I shall do so as shortly as possible.

The function of the teacher of bacteriology in relation to the medical student is, I take it, to furnish him with the minimum amount of bacteriology which will enable him to understand the clinical cases he will come in contact with when he goes into practice. There are three main lines along which this instruction must go. First of all the student must have a knowledge of the part which bacteria play in the initiation of disease processes and in the phases of the successive phenomena which emerge during the progress of a clinical case. Secondly, the practitioner in modern times must be possessed of such bacteriological knowledge as will enable him to undertake those methods of treatment which have a bacteriological basis, methods which involve the application of sera, vaccines, and so on, to the treatment of disease. And thirdly, the practitioner must have a knowledge of how, during the life of the patient, he can get information as to the cause of the disease by the bacteriological examination of various exudates and of other material derived from a case; if, when he goes into practice, he does not undertake these examinations himself—which usually, of course, he does not—he must know what precautions ought to be taken in order that the material may be sent to a clinical laboratory in proper condition, and he must further be able to interpret the reports which he receives from such a clinical laboratory. These are the three objects which the bacteriological teacher must have in view in dealing with the medical student. The dominating factor of the situation is this, that bacteriology must be treated as a branch of pathology. In modern times pathology has gained a new insight into the processes of disease by the knowledge which has been acquired by the bacteriologist. The phenomena of inflammation become more and more intelligible when considered from the bacteriological standpoint, and a new interpretation is given to the conception of the reaction of the body to disease which plays such a great part in pathological processes. In fact, it may be said that it is bacteriology which has placed this conception of reaction upon a scientific basis, for although reaction is in essence a physiological process, it only finds proper elucidation when examples are taken from what occurs when bacteria get entrance into the body and call out phenomena which represent the fighting power of the organism. From its own standpoint, bacteriology gains much from association with pathology; if in connection with medicine it is not associated with pathology it becomes a

very inferior and incomplete branch of botany. Therefore it is essential, I think, that in trying to work out, as we are doing here, the place which bacteriology is to hold in the medical school, we should make the teaching a part of the pathology course. As Professor Lorrain Smith has indicated, that is what is being done in this school now. I cannot do better than follow his example, and give an outline of how at present this is actually worked out.

First of all there are the systematic weekly lectures, twenty in all, during the two terms of the systematic course. We have already had a considerable expression of opinion here as to the place which systematic lectures are to occupy, and I would like to say that as matters are at present constituted, it seems to me that the systematic lecture occupies a very integral part of the course. It is all very well to say that a student can get up his information from text-books. In bacteriology, to ask a student to get up a text-book is simple cruelty, because there is no text-book that does not give a great deal more than is necessary for the ordinary medical student to know. And further, unless there is regular tutorial supervision of the reading of the student—such as exists in the older English Universities—he will not read what he ought to read at the proper time: without such supervision he can have no guidance as to what he ought to read and what he ought to leave out. The systematic lecture does to a certain extent supply this guidance. In the lectures given in the pathological department here the main points regarding, not uncommon diseases, but the common bacteriological diseases of man are taken up and emphasised, and thus the student gets to know what is important and what he may pass by. As far as possible the lectures in bacteriology are correlated with the other systematic lectures in pathology. For instance, Professor Lorrain Smith commences his course with a consideration of inflammation. At the same time I take up a simple bacteriological inflammation, such as pneumonia, and follow that up with the more complicated case where suppuration is interposed as a stage in inflammation. Then one goes on to deal with an example of a chronic reaction to a long-standing irritant such as one finds in tuberculosis. I may say here that not only are the lectures on bacteriology correlated with the lectures on pathology, but they are also correlated, when opportunity arises, with the practical work which is being done in the morbid anatomy class. For instance, this year the students were doing a case of tuberculosis, and I took up tuberculosis and treated of the points which were raised in the actual case the students were working at in the pathological department of the Infirmary. In the twenty lectures one can deal thoroughly with the ordinary infections, inflammation, suppuration, tuberculosis, a pure intoxication like diphtheria, and the more complicated pathological picture found in infections with the typhoid organism, and meningitis, gonorrhœa, syphilis, and other infections

are also dealt with. Then we go on to more general bacteriological pathology, taking up the lesions which bacteria are capable of originating. Then we have to tackle the difficult task of giving the student such knowledge as he requires regarding modern methods of treatment which have a bacteriological basis. This leads us into the realms of immunity, which I never approach without trepidation! Here I try as far as possible to give as many of such facts as there are, and not to allow my imagination to soar into those regions of fancy to which Professor Dean has alluded. When all is said and done, the fundamental facts of immunity are few; they are, however, not simple, and it is the most difficult task of the bacteriologist to get the ordinary medical student to comprehend them.

With regard to the practical work, this consists of ten meetings. In the October term the men who have had out practical pathology the previous summer have their bacteriological course, and after Christmas the men who began their pathology in October have theirs. In that way one can reduce the size of the classes to reasonable limits; we aim at having not more than fifty in a practical class. Further, we aim at having a student demonstrator for about every eight students in the practical classes. I consider this supervision by student demonstrators absolutely necessary, and I do not think that one demonstrator can attend to more than ten students at most at a time. In this practical course no attempt is made to give the students an intimate knowledge of bacteriological methods. They do not make culture media; they have the methods of making them demonstrated to them. But they themselves put up a series of preparations of ordinary organisms and of morbid tissues containing these organisms, and thus they practise all the ordinary elementary staining and cultural methods. They also have to do certainly one experiment in agglutination, but beyond that the serological methods (for example, the Wassermann reaction) are left to demonstration.

There is a third series of classes which we have developed within the last two years, and which, I think, will prove the most valuable part of the ordinary bacteriological course. In this third section, which comes after they have had the elementary practical class, the students are divided up into small groups, the size of which depends upon the size of the class—say about ten to eighteen students in each group, and they work at *clinical bacteriology*. Each student goes through a course of eight meetings of two hours each devoted to this subject. We take any material which may have come in to the three laboratories at our disposal — sputa, pus, urine, fæces, cerebro-spinal fluid, etc. We give the material to the students without telling them what they are to do with it. They must discuss what ought to be done, and, of course, we give them direction in deciding this, and then they proceed to do whatever is necessary for

the preparation of a report. In this way they get to know what can be done by clinical bacteriology and its limitations, and I think this work will help them to interpret reports which they will receive from clinical laboratories when they go into practice. At the end of this short course they have to send up their slides and the notes they have taken. In these notes they must state the problems they have studied, the methods employed, and the report which they would issue. These notes are gone over and criticised in order to show them where they have succeeded and where they have failed.

This, then, is briefly the instruction given at the present time to the students of pathology in the branch of bacteriology. More and more we are trying to bring bacteriology into correlation with clinical medicine, just as in the other branches of pathology, and I hope that in the future there will be still further development along the lines of encouraging the men, who are working in the wards, personally to take material from the cases they are interested in and to work it up, and such observations will, I trust, come to be a feature in the reports which they submit to their clinical teachers in the ordinary course of their ward work.

DISCUSSION.

Dr. James Miller.—There are many ways of preparing a student for examination, but there are far fewer ways of teaching him a basic understanding of the subject. Probably the oldest way was for a man with a message—the professor—to gather round him a group of disciples, and by a system of question and answer and an interchange of ideas to work out the subject. That, I take it, is still the best way. Somewhere in the Middle Ages the system of lecturing from a chair was introduced. It has its advantages, and in the hands of a proper teacher who can impress his personality upon the student may be very valuable, but it cannot be compared with the other method adopted by Professor Lorrain Smith in the teaching of morbid anatomy. It interests the student, and it brings him into touch with the patient.

Dr. Edwards has drawn attention to the fact that the pathologist tends to degenerate unless he carries on research; but there is another thing that he *must* do—he must keep in touch with the clinical aspect of affairs, and this method of teaching pathology forces him to do so. I must cite some disadvantages, but they are not inherent in the method. One is, that it necessitates a large staff; a single individual cannot carry out this method of teaching. The men must be gathered in groups, and by the system of asking and answering questions the requisite knowledge must be instilled into their minds. Secondly, this method imposes a great amount of work on the teacher in annotating and criticising the notes of the students, without which justice would not be done to the individual. The method also tends rather to widen the gap between the bad and the good student. It increases the number of good students undoubtedly, but the others, I think, tend to fall behind, and require "coaching" to get through their examination.

No student ought to leave the university without having done at least

one post-mortem examination, and knowing how to carry it out. One would also like to give him a little more instruction on how to send material for examination to the pathologist.

Dr. Stuart M'Donald.—The discussion to-night shows us that pathology is indeed alive, and that it is now being widely recognised that, if it is going to mean anything at all, pathology must be brought into direct relation with clinical medicine ; and also, that in planning the education of the medical student, we are aiming at turning out a first-class general practitioner and not a specialist in pathology.

With reference to the necessity of teaching the average doctor how to perform a post-mortem, I agree that it is desirable ; but will one, will twenty, will fifty post-mortems teach him? I question very much. One sees the most fearful attempts at post-mortem examinations made by colliery doctors in compensation cases, and seeing these one realises how important it is that during the time a man is studying medicine he should be given the amount of information which will enable him at some subsequent date to do a post-mortem thoroughly.

I agree with Professor Dean that pathology should be divided into two parts. There should be, as soon as the student has finished his examination in anatomy and physiology, a short course of general pathology, which would serve as an introduction to his clinical work ; and later in the course—not necessarily all at once—there should be an extension of that teaching—possibly one lecture a week throughout the rest of his course would meet the position rather than a separate complete course at a fixed period in the curriculum. Personally, I find in trying to teach pathology nowadays that the subject is too huge to get through in the time at our disposal, so that we can only try to teach general principles, and hope to keep the students' interest in pathology alive by the demonstrations later in the course. With Professor Lorrain Smith's case method I am familiar, and I have with some success endeavoured to carry it out in my own classes, although I think that he meets with more success here, because in this school the men start medicine earlier than with us. The special advantage of the case method is that the men are taught to think, and any method which makes the student think is to be encouraged. The case method is only an extension of what was done for clinical medicine here by Sir Thomas Grainger Stewart, who taught first and foremost the great importance of studying one case thoroughly. I quite agree that two or three cases studied as those of Professor Lorrain Smith have been studied will do infinitely more for the student than a whole course on the old lines.

With regard to the education of the students in clinical pathology, I feel that more use could be made of the appointment of pathological clerks, and that it should be the duty of the clerk attached to the pathological department not only to see the post-mortems and to assist in writing up the notes of them, but he should also be brought more in contact with the clinical material which is going through the wards, to see what can be gained by a study of disease from that direction.

Regarding most of the aids to diagnosis in the direction of clinical pathology, what we want is to teach the student what he is likely to gain by sending his material to a competent observer rather than to teach him to make the observations for himself.

The pathologists should not claim any more time than is at present allotted to them in the curriculum. I will yield to no man in my idea of the importance of pathology in medicine, but at the same time we must recognise that a student might spend too much time at pathology, and that anything tending to take him away from the actual study of the clinical case is to be deprecated: but I do feel that the time he already spends at pathology might be of more value if it were brought into more direct touch with clinical medicine. For the last three years I have been more of a physician than a pathologist, and although I regret the time in many ways, yet I think I have had valuable experience, which has made me infinitely more sympathetic than I was before, and will probably make a better pathologist of me in the end. At Newcastle just now we are concerned with a big scheme for the extension of our hospital. Together with that there will be a considerable addition to the pathological department, and in a report I am sending in presently with regard to the developments there, I have proposed that the pathological department should be taken quite out of the College of Medicine and put in the middle of the Infirmary. Until pathology is in absolute touch with clinical medicine we will never get the best results.

Dr. R. D. Clarkson congratulated the students of to-day on the fact that pathology is no longer divorced from medicine ; yet he felt that the students might easily devote too much time to pathology. To the pathologist a complete case is a case that has come to the post-mortem table : here there are so many changes that he feels could not possibly be influenced by drugs that he loses his faith in drugs, and becomes, from the point of view of the general practitioner, not quite so good as he might be. Enough stress is not laid upon the teaching of the processes of repair and compensation in the human subject. The "case method" does lead to it, but the case is not studied as it is recovering from the disease but as it has died from it.

Major Ruggles.—I should like to emphasise, from my own experience, the correlation of the normal with the abnormal by the study first of the normal tissues and then of those which show preliminary and later changes of a pathological nature. One of the greatest tributes that can be paid to pathology in my own country is that more than half of our foremost teachers of clinical medicine have laid the foundation by a special study and, in most cases, by the teaching of pathology. To become a teacher of clinical medicine it has become necessary to have first been a teacher of pathology.

Another point that occurred to me is the possibility of establishing a closer relationship between surgery, as well as clinical medicine, and pathology. A great deal of good would be done if the teachers of pathology could induce their pupils to enter the operating-room with a greater interest in the pathological condition of the case. In the Massachusetts General Hospital good use is made of pathological material through the circulation of case reports. The hospital has a course open to men in their last year, which consists of the study of the case reports and of the actual cases in the wards—surgical and medical. When the cases do not get well they are followed to the post-mortem room. Before the post-mortem is performed, the surgeon, the medical man, and the laboratory man, and perhaps some of the classes, are asked from the history and the temperature chart to make a differential

diagnosis. These are recorded, and then the post-mortem is conducted. This is done in all teaching hospitals, and then the cases are printed and circulated. This circulation has grown enormously, and serves to keep people in non-teaching hospitals, and men in general practice, in touch with present-day methods of treatment and pathological examination. It has stimulated a great many men not only to a more thorough clinical study of their cases, but also to more earnest efforts to obtain post-mortem examinations.

Dr. Fowler.—Like Dr. Edwards I have been struck by the unfamiliarity with the methods of clinical pathology shown by many practitioners. I have lately had an opportunity of seeing a good deal of the work of men of different ages, and from different schools, and their knowledge of clinical pathology was undoubtedly below their knowledge of general medicine. This does not refer to the more complicated methods of diagnosis, but to such simple technical matters as making blood-smears and the like, which have been in routine use for twenty years. The blame for this appears to me to rest more with the clinical teachers than with the pathologist. For all that has been said there does not yet generally exist a real co-operation between clinicians and pathologists. The pathologist ought, I think, to be treated like any other specialist, and asked to see difficult cases with a view to suggesting possible methods of diagnosis. If students saw clinical pathology from this point of view they would better understand its importance, and in what sort of cases it is of value.

Mr. D. P. D. Wilkie said that although there were obvious reasons why surgical cases did not lend themselves so well to pathological investigation as medical ones, it was desirable to have on the staff of the pathological department one surgical pathologist (possibly a junior member of the surgical staff) who would conduct the surgical post-mortems. He urged the importance of more systematic collection and preservation of surgical specimens for teaching purposes.

Dr. Chalmers Watson advocated closer co-operation between the clinician and the pathologist in the interpretation of post-mortem findings to the students. The clinician is responsible for the fact that bacteriology is not more definitely correlated with medicine. The *rôle* of bacterial infection, *e.g.* from carious teeth, in causing disease is fully recognised, but the facilities for counteracting it are inadequate, even in large hospitals.

Dr. J. V. Paterson considered that the case-method of teaching pathology constituted a revolution rather than merely a reform. It reminded him of Kolisko's brilliant naked-eye demonstrations in morbid anatomy, from which he first learned the importance of correlating pathological changes with what is seen in the wards.

Dr. Traquair said that the public requires to be educated as to the value of laboratory investigation as an aid to diagnosis.

Dr. J. H. Gibbs emphasised the importance of directing the students' attention to the earlier stages of disease. If adequate attention were paid to dental treatment a great many diseased processes would be checked at the beginning, or possibly light would be thrown on the commencement of many chronic diseases.

RECENT ADVANCES IN MEDICAL SCIENCE.

DISEASES OF CHILDREN.

UNDER THE CHARGE OF

W. B. DRUMMOND, F.R.C.P., AND A. DINGWALL FORDYCE, M.D.

Hypertrophic Stenosis in Infants.

Holt (*Brit. Journ. of Child. Dis.*, July to September 1917) contributes a paper on this subject based upon the study of 141 cases. Diagnosis is discussed under the following headings, which are arranged in the order of their significance :—(1) The history, if obtained from a reliable mother or nurse. (2) Abnormal gastric retention, observations being repeated four or five times at least. (3) Peristaltic waves, not of diagnostic value unless typical. (4) The presence of a palpable tumour. (5) Wasting, constipation, scanty urine, etc.

Treatment is discussed in detail. The chief conclusions are as follows :—(1) Hypertrophic stenosis of the pylorus in infancy is a pathological entity. It should not be confused with other pathological conditions, which may be accompanied by vomiting and occasional gastric peristalsis. (2) Many of the milder forms recover with only medical treatment. (3) All those which do not improve under such treatment in the course of two or three weeks, and the more severe types in a much shorter time, should be treated surgically. (4) The symptoms which indicate surgical intervention are rapid loss in weight, persistent vomiting, and forcible gastric peristalsis; the presence of a palpable tumour and abnormal gastric retention aid much in diagnosis. (5) The X-ray reveals nothing of importance which cannot be discovered by a study of gastric retention, and without its dangers. (6) The cases which come under observation after four or five weeks of vomiting and marked loss in weight are best treated by operation as soon as the diagnosis is established. (7) The earlier operations of gastro-enterostomy, divulsion, pyloroplasty, etc., were unduly severe and prolonged; they should be abandoned for the simple external division of the circular muscular fibres proposed by Rammstedt. (8) Results by the same operator, upon the same class of cases in the same institution and with the same treatment, show the great superiority of the Rammstedt operation to gastro-enterostomy and to medical treatment. (9) Cases of gastro-enterostomy followed from four to eleven years indicate that growth and development are not impaired by the operation. (10) Cases followed two and three years after the Rammstedt operation show no interference with health and progress. (11) Cases not operated on usually show no symptoms after the first

year. Yet the possibility that this condition may be the basis of pyloric obstruction in later life undoubtedly exists.

Sill contributes a paper on the same subject (*New York Med. Journ.*, c. 3). Stress is laid on the suggestiveness of projectile vomiting and the peristaltic abdominal wave, associated with loss of weight and marked constipation. Early cases may be treated medically by lavage twice daily, with small doses of opium or atropine to allay spasm. The best diet is breast milk, diluted if necessary; failing that, modified cow's milk, which should be low in fat and sugar, may be given. If a distinct pyloric tumour is palpable, a surgical operation is indicated.

The number of the *British Journal* quoted above contains an abstract of a paper by Francioni (*Riv. di Clin. Pediat.*, 1917, xv.) on "Congenital Stenosis of the Duodenum." A child, aged 47 days, was admitted for vomiting. The urine contained reducing substances, and lactase was present in the fæces. The duodenum was dilated as far as the opening of the bile-duct, at which point the mucous membrane was ulcerated and the communication with the rest of the duodenum was only large enough to admit a small probe.

Cockayne publishes a paper on "A Case of Congenital Defect of the Duodenum in which Bile was found both Above and Below the Absent Portion" (*Proc. Roy. Soc. of Med.*, June 1917). Congenital occlusion of the duodenum is a rare condition. Cowell, in 1912, was able to collect only ninety-two cases, and few have been described since. The presence of bile above as well as below the stenosed piece of gut is generally due to a branched bile-duct. In the present case no branch to the upper portion could be discovered, and the presence of bile in the upper portion is attributed to the swallowing of amniotic fluid stained by meconium. The liquor amnii was of a green colour.

Diabetes Insipidus in Children.

The literature concerning diabetes insipidus in general is quite extensive, despite the relative rarity of the condition. That which deals especially with the affection in children, however, is limited, both in scope and volume. In many of the text-books on pediatrics the subject is disposed of with a few lines, or, at most, a few pages; and the major number of references encountered are found to be merely reports of cases.

Moffett and Greenberger contribute an elaborate paper on this subject (*Med. Record*, New York, 22nd September 1917), and give a bibliography with 166 references. The following is their own summary of their paper:—Diabetes insipidus is a disease which is characterised by polyuria; polydipsia; absence of sweating; anorexia, appetite poor; constipation the rule; ocular changes (cataract, xanthoma palpebrum, pigmentary choroiditis, incipient or advanced optic atrophy,

etc.); headache; lumbar pains; impotence; blood changes—slight; loss of weight; œdema of feet; knee-jerks exaggerated; metabolism not much disturbed. A study of the cause of the polyuria, from a careful investigation of a large number of histories of this condition and from the careful observations which we made in studying our reported case, leads us to believe that the whole chain of symptoms, which is so characteristic and which is always present in the true cases, has its fundamental origin in the pituitary gland and not in other parts of the body. We must disagree with Eric Meyer and his co-workers, for we do not believe that the changes in the concentration of the urine are due to a primary disorder of metabolism, but that the changes in metabolism of the body are secondary to the disease which is present in the pituitary body. This change in function which takes place reacts undoubtedly upon other glands of internal secretion and upon the entire organism. There is a good deal of evidence which leads us to believe that the changes which have been observed by Tallqvist, Meyer, Socin, and others in the kidney vessels themselves are only part of the result of absence of pituitary secretion. During the course of our exceptional opportunity to study the case here reported, we were able to try the effect of reduction in the amount of sodium chloride intake and of water intake over a considerable period of time, which can be seen by an examination of the chart in the text. These various experimental observations did not prove helpful at all, for the case continued passing the same large quantities of urine notwithstanding the reduction in the amount of sodium chloride intake. This observation has been made by other workers in the same field, and the unsatisfactory results obtained lead us to the investigation of the pituitary body as a possible cause of the entire condition. Our observations showed that injections of a half cubic centimetre of pituitary extract two or three times a day lessened the amount of urine output to a very marked degree, there being a drop of from 7000 or 8000 c.c. to 1500 to 2500 per day. This same observation has been made by Schäfer and Magnus, Frank, Simmonds, Cushing, and others.

Status Lymphaticus from a Clinical Standpoint.

A communication on the condition or conditions known as status lymphaticus, status catarrhalis, exudative diathesis, and (in French literature) neuro-arthritis is published by Cameron in the *Proceedings of the Royal Society of Medicine*, June 1917. Cameron states that the condition, regarded by some as a rare one, is very common among the London poor. It is present in 40 per cent. of post-mortems at Guy's Hospital upon children who have not become emaciated before death. Cameron's somewhat speculative opinions may be summed up as

follows:—(1) That the lymphoid overgrowth so commonly found post-mortem in children is no more than an enlargement from the irritation of chronic catarrh in the corresponding mucous membranes. (2) That such children during life show evidence of faulty nutrition or infection of all epithelial structures—hair, skin, teeth, conjunctiva, and the mucous membranes of respiratory and intestinal tracts. (3) That there is usually present a characteristic wateriness of the tissues, which is dependent to some extent upon excessive carbohydrate feeding, which is a main cause of the vulnerability to infection. (4) That local treatment of the catarrhs alone is likely to be inefficacious, and must be accompanied by a systematic attempt to bring about the process of dehydration and improve the nutrition of the tissues. The greatest good can be achieved by persisting for many months in a carefully controlled diet in which the starches and sugars are reduced to a minimum. The diet recommended consists chiefly of skim milk, meat, fish, eggs, green vegetables, and fruit, calculated so as just to cover the physiological needs of the child, and controlled by its effect upon the visible catarrhs and palpable glands. (5) That the status catarrhalis in the sense defined is a predisposing cause of rheumatism and tubercle, and carries with it a liability to sudden death at the onset of virulent infections, such as pneumococcal infections, measles, or diphtheria.

Lipo-dystrophia Progressiva in a Male.

This case is described by Weber (*Proc. Roy. Soc. of Med.*, June 1917). A boy of 13 began to look thinner in the face at the age of 8. For the last three years there has been practically no fat in the face or neck, but there is a fair amount in the buttocks and lower extremities. Owing to the loss of fat in the upper part of the body the condition known as "elastic skin" has resulted. The boy feels well, and is quite intelligent. A table of ten cases in males is published.

Influence of Labour on Brain Development.

Groszmann (*New York Med. Journ.*, 3rd November 1917) pleads for a more systematic study of the obstetric conditions which may cause feeble-mindedness. In addition to trauma he mentions several other probable causes—functional weakness on the part of the mother, either on account of local inefficiency or through cardiac exhaustion; a series of still-births or miscarriages, any child who survives in such cases being likely to be handicapped physically and mentally; and attempts at the procuring of abortion.

Treatment of Asphyxia Neonatorum.

Allen (*Long Island Med. Journ.*, September 1917) asserts that in the United States one hundred thousand infants die annually from asphyxia neonatorum, chiefly through the want of efficient treatment. The treatment recommended is as follows:—(*a*) Preserve the body heat—this is most important; (*b*) clear the throat of mucus, etc.; (*c*) inflate the lungs by means of a resuscitation horn. This instrument, which is illustrated, looks somewhat like a very fat stethoscope. It has a valve in its interior. Inflation is carried out by the breath of the physician, to which oxygen may, if desired, be added through a tube in the side of the horn. W. B. D.

NEW BOOKS.

The Carnegie United Kingdom Trust: Report on the Physical Welfare of Mothers and Children, Scotland. Volume III. Pp. 632 + xviii. By W. Leslie Mackenzie, M.A., LL.D., M.D., D.P.H., F.R.C.P.E., Medical Member of the Local Government Board for Scotland. The United Kingdom Trust: East Port, Dunfermline. 1917.

There can be little doubt that Dr. Leslie Mackenzie's Report on Scottish Mothers and Children will be consulted for many a day for its rich stores of facts by all people interested in the welfare of the coming race of infants and children. It forms a worthy companion volume to the two already published which have England and Ireland for their sphere. Dr. Mackenzie has wisely drawn largely on the information supplied to him by specialists, but he has at the same time so welded together the details and so ably commented upon the results as to make a most readable and inspiring volume. The six hundred fully packed pages and the admirably chosen illustrations and map are not too many for a subject of such vital importance as the health of the nation's young life; and a feeling of wonder comes into the mind of the thoughtful student of medicine, social progress, and ethics that it is only now, well on in the twentieth century, that legislators and hygienists are seriously turning their thoughts to the lessening of the death-rate among young children, which is seen to be grossly in excess of what it ought to be. The marvel is that this startlingly high mortality has been so long accepted as a sort of "normal" statistical phenomenon; this Report makes it impossible any longer to entertain such a thought.

The Edinburgh School of Surgery before Lister. By ALEXANDER MILES. Pp. 220. With 8 page Illustrations. London: A. & C. Black, Ltd. 1918. Price 5s. net.

MR. MILES has done the profession a valuable service in telling the story of surgery in Edinburgh before the time of Lister. It is specially opportune at the present time. In the welter of a great war, when different surgical methods are on their trial, it is gratifying for Edinburgh men to know that the foundations of the great principles on which the science and art of surgery are built, apart from Listerism, were largely laid in the "Old Royal" by the great men who worked there in the first half of the nineteenth century.

The author traces the development of surgical teaching from the year 1505 down to the middle of last century, when Syme, with his wonderful diagnostic acumen and almost uncanny skill with the knife, became a veritable Wizard of the North.

The story of the building of the Royal Infirmary and the gradual development of surgical practice and teaching is told in a graphic and picturesque manner, and short biographies are given of a few of the outstanding figures as they arose. Lang Sandy Wood, the Bells —Benjamin and John—(of different but equally talented families), John Thomson, Lizars, Liston, Ferguson, and Syme have their work described, and their foibles and quarrels (which were many) adverted to.

The book throws interesting sidelights on the social life of Edinburgh at the most glowing period of its history, and proves that its surgeons were able to hold their place with the brilliant wits who at that time made Edinburgh their home. It is a fascinating tale, and should appeal to all old Edinburgh men.

The book is neatly got up, and contains a number of most interesting illustrations, but we miss one of the old Surgeons' Hall, which, next to the Hospital, was the centre of surgical activity for more than a hundred years.

Human Physiology. By Professor LUIGI LUCIANA. Translated by FRANCIS A. WELBY, with an Introduction by Professor J. N. LANGLEY, F.R.S. In Five Vols. Vol. IV. The Sense Organs. Edited by GORDON M. HOLMES, M.D. Pp. 519. 8vo. With Illustrations. London: Macmillan & Co. Price 21s. net.

THE high standard of the first three volumes of Luciana's *Physiology* is well maintained in this volume on "The Sense Organs," and again we marvel that one brain can hold such an intimate and comprehensive insight into the various problems of physiology.

The method of introducing each subject by giving a survey of the work done is extremely valuable, and brings the subject before the

student in the proper perspective. This is done without any undue elaboration of details, while, on the other hand, the discussion of results and their bearing on the problem is ample.

In estimating the value of the results obtained by the various workers in any subject the author's judgments are extremely well balanced. His critical remarks are very acute and appear to be unusually free from bias, even where results which are in contention with the views of the author are being discussed.

The least adequate section is that on psycho-physics, but nevertheless these chapters are a valuable addition to the work.

The chapter on tactile sense, both from the histological and physiological points of view, is especially good, the treatment being clear and concise.

Miss Welby is to be congratulated on her work. The text reads without any of those peculiarities of expression or construction which usually characterise a translation.

The volume is well indexed for authors and for subjects.

Blood Pictures. By Cecil Price-Jones, M.B., Capt. R.A.M.C. Pp. 92. With 5 Illustrations. Bristol: John Wright & Sons, Ltd. 1917. Price 6s. 6d. net.

The purpose of the author is to put into the hands of the clinician and general practitioner not an extensive work on hæmatology but a manual, small in bulk and of moderate price, containing the essentials necessary for the diagnosis of blood diseases. It is intended also to serve as a guide in the interpretation of the results of blood examination in various forms of bacterial and protozoal infection, in malignant disease, intestinal stasis, etc. Several examples of blood counts from actual cases are given.

The book contains five coloured plates illustrating the normal and abnormal elements of the blood and the phylogenesis of the corpuscles.

Britain's Heritage of Science. By Arthur Schuster, F.R.S., and Arthur E. Shipley, F.R.S. Pp. xv. + 334. With 15 Illustrations. London: Constable & Co., Ltd. 1917. Price 8s. 6d. net.

Here is a straightforward and conscientious account of the research and achievements of British scientists from Roger Bacon's day down to our own. For the most part the authors have covered the vast field before them by giving biographical accounts of the leading figures, with the praiseworthy result that their book has for the general reader a personal interest, often lacking in this class of literature. Although

the book is presumably intended mainly for the lay reader, its authors have avoided the temptation (or better, perhaps, have not felt it) of "writing down" to the unprofessional mind by the affectation of an easy arm-chair style. The expert in botany or physiology, zoology or physics, need have no fear that his time will be wasted in studying these pages. Better still, the collaborators have not fallen victims to a contemporary malady of appraising British achievement by stentorian depreciation of continental work. There are fifteen interesting portraits in the book, several of them unfamiliar, almost all of them of men whose names and features and histories should be far more familiar to educated men than they are to-day.

The Dawn of Mind: An Introduction to Child Psychology. By MARGARET DRUMMOND, M.A. Pp. xi. + 179. London: Edward Arnold. 1918. Price 3s. 6d.

MRS. DRUMMOND'S new book is in every way worthy of her high reputation. In the present volume her attention is mainly confined to the growth of the child-mind during the first three or four years of life, but, as she clearly shows, the close study of these early days is of the greatest possible value, both as regards the child himself and as a sidelight on questions of general psychology. Now that education is at last becoming a subject of general interest, it is more important than ever that we should understand the material with which it has to work—the developing mind of the child. In education rule-of-thumb is no better than a reign of terror. To teachers and parents alike no better introductory study could be recommended than this most readable volume.

BOOKS RECEIVED.

Bowen, William Pardon, and R. Tait M'Kenzie. Applied Anatomy and Kinesiology *(Lea & Febiger)* dols. 3.50.

Brown, Lawrason. Rules for Recovery from Tuberculosis. Second Edition *(Lea & Febiger)* dol. 1.55.

Burnham, A. C. First Aid and Emergency Treatment . . . . *(Lea & Febiger)* dols. 2.00.

Cumston, Dr. Charles Greene. Francois Rabelais . . . *(Librairie Georg et Cie)* —

Depage, Dr. A. Ambulance de "L'Océan" for December 1917 *(H. K. Lewis & Co., Ltd.)* single copy, 14s.

Emery, W. d'Este. Tumours: Their Nature and Causation . *(H. K. Lewis & Co., Ltd.)* 5s.

Flint, Austin. A Manual of Physical Diagnosis. Seventh Edition, revised by Henry C. Thacher . . . . *(Lea & Febiger)* dols. 2.50

Greenwood, Wm. Osborne. Scopolamine-Morphine: Semi-Narcosis during Labour *(Henry Frowde and Hodder & Stoughton)* 6s.

Harrison, L. W. Diagnosis and Treatment of Venereal Diseases in General Practice *(Henry Frowde and Hodder & Stoughton)* 21s.

Hewlett, R. Tanner. A Manual of Bacteriology. Sixth Edition . *(J. & A. Churchill)* 14s.

Jones, H. Lewis. Medical Electricity: A Practical Handbook for Students and Practitioners. Seventh Edition, revised and edited by L. W. Bathurst *(H. K. Lewis & Co., Ltd.)* 15s.

Leftwich, R. W. Aids to Rational Therapeutics . . . *(Bailliere, Tindall & Cox)* 3s. 6d.

Lumb, N. P. L. The Systematic Treatment of Gonorrhœa . . *(H. K. Lewis & Co., Ltd.)* 4s. 6d.

Maclean, Hugh. Lecithin and Allied Substances: The Lipins *(Longmans, Green & Co.)* 7s. 6d.

Macleod, J. M. H. Burns and their Treatment *(Henry Frowde and Hodder & Stoughton)* 6s.

Norris, George William. Blood-Pressure: Its Clinical Applications . *(Lea & Febiger)* dols. 3.50.

Pearce, Richard Mills. The Spleen and Anæmia . . . . *(J. B. Lippincott Co.)* 21s.

Ruhrah, John, and Erwin E. Mayer. Poliomyelitis . . . *(Lea & Febiger)* dols. 3.25.

Thresh, John C. A Simple Method of Water Analysis. Ninth Edition *(J. & A. Churchill)* 3s.

Willoughby and Cassidy, Drs. Anti-Malarial Work in Macedonia *(H. K. Lewis & Co., Ltd.)* 3s. 6d.

Wilkins, Coleman and Preston. First Lessons in Spoken French for Doctors and Nurses. Third Impression . . . . . *(The University of Chicago Press)* —

Wilson, J. C. The Complete Medical Pocket-Formulary. Sixth Edition, revised by C. H. Turner . . . . *(J. B. Lippincott Co.)* 10s. 6d.

EDINBURGH MEDICAL JOURNAL.

EDITORIAL NOTES.

Anopheles in Scotland.

Dr. J. H. Ashworth, F.R.S., Department of Invertebrate Zoology, University of Edinburgh, appeals to all interested to collect and forward to him specimens of anopheles mosquitoes from any part of Scotland. Three species are known to occur, and two of these are carriers of malaria in other parts of Europe. The appeal is made with the object of attempting to ascertain the present range of distribution of the three species of anopheles in Scotland. The information so obtained would be of value (1) for enabling some comparison to be instituted between the areas of distribution of anopheles and the areas where ague formerly occurred (ague disappeared from Scotland less than one hundred years ago); and (2) in connection with any precautions which it may be desirable to take against the possible introduction of malaria owing to the return of infected persons from abroad into areas where malarial carrying species of anopheles are present.

Appointments.

The Curators of the University of Edinburgh have appointed Mr. Arthur Robertson Cushny to the Chair of Materia Medica, in succession to Professor Sir Thomas R. Fraser, resigned.

The Secretary for Scotland has appointed Dr. Norman Walker to be Inspector of Anatomy for Scotland in succession to the late Sir James A. Russell.

CASUALTIES.

Died of wounds on 10th April, Captain John A. Mackenzie, R.A.M.C. (attached Durham Light Infantry).

Captain Mackenzie graduated M.B., Ch.B. at Edinburgh University in 1916.

Died of wounds, Captain Duncan Mackinnon, R.A.M.C.

Captain Mackinnon graduated M.B., Ch.B. at Edinburgh University in 1909.

KILLED in action on 15th April, Captain BERNARD SCOVE BROWNE, M.C., R.A.M.C.

Captain Browne, after graduating M.B., Ch.B. in Edinburgh University, went out to China as a medical missionary and was surgeon to the Chinese Customs Service at Ningpo.

DIED of injuries on 1st May, Surgeon ROBERT WILLIAM BRANDER, R.N.

Surgeon Brander graduated M.B., Ch.B. at Glasgow University in 1914. He acted as House Surgeon to the Regius Professor of Surgery at Glasgow.

KILLED in action on 27th April, Captain IAN KEITH-FALCONER, R.A.M.C.

Captain Keith-Falconer, after graduating M.B., Ch.B. at Edinburgh University in 1914, acted as House Surgeon in the Royal Infirmary.

DIED of wounds on 25th April, Captain HUGH SALISBURY PALMER, R.A.M.C.

Captain Palmer graduated M.B., Ch.B. at the University of Edinburgh in 1914.

KILLED in action on 26th March, Major REGINALD GLEGG GORDON, D.S.O., R.G.A.

Major Gordon graduated M.B., Ch.B. at Edinburgh University in 1903, and after devoting some years to the study and practice of mental diseases gave up practice in favour of farming. He received the D.S.O. in January 1918.

KILLED in action, Captain PATRICK GEORGE MILNE, R.A.M.C.

Captain Milne graduated M.B., Ch.B. at Aberdeen University in 1915.

KILLED in action, Captain THOMAS WHITELAW, R.A.M.C.

Captain Whitelaw graduated M.B., Ch.B. at Glasgow University in 1912.

DIED on service on 2nd May, Captain WILLIAM M'QUIBAN, R.A.M.C.

Captain M'Quiban graduated M.B., Ch.B. at Aberdeen University in 1901.

STUDENTS OF MEDICINE.

DIED of illness contracted on active service, Lieutenant RICHARD VASSIE.

Lieutenant Vassie was a third-year student at Edinburgh University at the beginning of the war, when he joined the Scottish Horse.

KILLED in action, Second-Lieutenant THOMAS F. GRANT, M.C., Seaforth Highlanders.

Before the war Lieutenant Grant was a student of Medicine at Edinburgh University.

KILLED on active service, Captain ALEXANDER KENNEDY, M.C., Royal Scots.

Captain Kennedy was a third-year student at Edinburgh University at the beginning of the war.

Temporary Commissions in Indian Medical Service.

APPLICATIONS for temporary commissions in the Indian Medical Service may be made to the Secretary, Military Department, India Office, S.W. 1. In applying, information should be given regarding qualifications, practical experience, age, and nationality. Knowledge of Indian languages and customs is essential.

Applicants will be required, if considered *primâ facie* suitable, to attend at the India Office for an interview with the Medical Adviser and for medical examination. If appointed, they will be required to serve wherever directed, service to be for the duration of the war unless Government should decide for any reason to dispense with an officer's services at an earlier date.

An outfit allowance of £30 will be issued. The rate of pay will be 24s. a day when serving with an Expeditionary Force, unless an applicant is liable to serve under the Military Service Acts, when it will be at the rates admissible for permanent officers of the Indian Medical Service. A gratuity will be awardable after the termination by Government of a period of satisfactory service with an Expeditionary Force overseas.

Wound pensions and gratuities will be granted under the conditions and on the scale authorised for permanent officers of the Indian Medical Service.

Family pensions and gratuities will also be granted under the conditions and on the scale authorised by the Royal Warrant or Warrants in force for the time being for the families of permanent officers of the Indian Medical Service.

INDIA OFFICE, 9*th May* 1918.

PERFORATED GASTRIC AND DUODENAL ULCER.

By W. Q. WOOD, M.D., F.R.C.S.(Edin.),
Temporary Assistant Surgeon to Edinburgh Royal Infirmary and
Leith Hospital.

This is a subject of the first importance, alike to the practitioner, who sees the case in the first instance, and to the surgeon, who is called upon to carry out the operative treatment. When the calamity of perforation of an ulcer of the stomach or duodenum occurs to a patient, his life is at once placed in the greatest jeopardy, and unless his condition is promptly recognised and correctly treated it is very likely to be fatal; at the same time, it is proper to say that if the right measures are adopted the prospects of saving the patient's life are distinctly hopeful.

It seemed to me that it would be of some interest to discover in what way the incidence and results of this catastrophe have been affected by war conditions. In view of the scarcity of medical men it might be expected that there would frequently be some delay in the practitioner seeing the patient and dealing with the emergency. It is a fortunate fact that the symptoms of perforation are usually so severe in their onset that the patient's relatives perceive the gravity of the condition and are able to give the medical man some idea of its urgency. It seemed of interest also to ascertain in what way the incidence of this disaster might be affected, especially as regards sex and age. A large proportion of the male civil population have now been called into the Army, and cases of perforated ulcer in these men are dealt with in military hospitals; so that the present series of cases is taken from what remains of the population outside the Army. It may be recalled also that about the time of the outbreak of the war the cases both of perforated gastric and duodenal ulcer operated on by Edinburgh surgeons between 1896 and 1913 were collected and analysed and the results published in this *Journal.* It should be of some value to compare the principal features of more recent cases with those observed in that investigation. The following series consists of thirty cases of perforated gastric and duodenal ulcers which represent the cases that have come under my care in hospital from the outbreak of the war until the beginning of February 1918. Some have been treated in the Royal Infirmary and the others in Leith Hospital. I have to thank my chiefs in these hospitals for the opportunity of operating on the cases.

Sex Incidence.—Of the thirty cases, twenty were classified as

perforations of the stomach and ten as perforations of the duodenum, but it should be kept in mind in this connection that in cases of perforation in the neighbourhood of the pylorus it is often very difficult, owing to induration and œdema around the ulcer, to distinguish with certainty the exact relationship of the ulcer to the pyloric orifice. It is generally recognised that, on the whole, gastric ulcer is more common in women than in men; the ratio has been stated as high as four to one. There is an impression also that perforation is a more common complication in the female than in the male, apart from the greater frequency of ulcer in the female sex. In the Collected Cases referred to above the ratio was 2·2 cases of gastric perforation in women to 1 in man. In the present cases the relative frequency is somewhat surprising; of the twenty gastric perforations, eleven occurred in males and nine in females, a ratio of 1 in women to 1·1 in men. If the duodenal cases are included we find twenty cases of perforation in men and only ten in women. Although the present series is small, this unexpected difference appears too marked to be a mere coincidence. If we keep in mind the large proportion of men who are absent on military service, the relationship becomes all the more striking. Whether this reversal of the usual sex incidence is to be attributed to the greater strain of war conditions on the remaining male population or to better health of the women—many of whom are now leading healthy vigorous lives in marked contrast to the indoor sedentary life which they previously led—it is difficult to say. The question of alterations in diet suggests itself, but it is hard to see why the male sex should be more injured by any change in the quality or quantity of food than the female and, in addition, the disproportion was evident in the earlier years of the war when the diet of the civil population was practically unaffected. It may be mentioned, nevertheless, that since July 1917 I have operated on eight cases, all of whom were males.

The fact that duodenal ulcer is more common in the male sex is well illustrated; out of the ten duodenal cases there was only one female. It was interesting to find in this female patient that in addition to the perforated duodenal ulcer, not only was there a marked hour-glass contraction of the stomach from an ulcer situated on the lesser curvature, but I have operated on her recently for a peptic ulcer of the jejunum in relation to the gastro-enterostomy opening. It would almost look as if the ulcer occurred in the duodenum in this patient because of a special tendency to

ulceration which she seems to possess, but a possible cause for the jejunal ulcer was found in the shape of the catgut employed in the gastro-enterostomy which was present unabsorbed at the end of eleven months. It is conceivable that the local irritation of the catgut was sufficient to cause this last ulcer, which was in close relation to the anastomosis. The ulcer was excised and the patient is now well on the way to recovery.

Age.—The youngest patient was a girl of 18, the oldest a man of 69, both having gastric ulcers. Seven of the gastric cases were under the age of 30 and thirteen over; three of the duodenal cases were under, and seven over, 30; that gives us a total of ten cases under 30 and twenty over. This shows a larger proportion of cases above 30 than usual, which may be partly explained by the absence of so many men under that age on military service. It may be noted that the prognosis in cases of perforated ulcer is not necessarily affected to any great extent by the age of the patient; this is illustrated by the fact that in the ten cases under 30 there were three deaths, while in the twenty cases over 30 there were six deaths, an exactly similar proportion in the two instances. It is interesting to notice, also, that of the four patients who were above the age of 60 all made excellent recoveries. The oldest, a man of 69, reports himself as having enjoyed perfect health since the operation about eighteen months ago. We may conclude, then, that elderly patients have quite a fair chance of recovery after perforation of an ulcer.

Occupation.—As was observed in the Collected Cases, the occupation of the patient seems to have no bearing on the liability of an ulcer to perforation. The occupation in the present series varied from the hard physical work of a ploughman to the indoor lighter duties of a housewife or domestic servant. One case occurred in a sailor attached to a mine-sweeper, who was so fortunate as to be ashore at the time of perforation.

History of Indigestion Previous to Perforation.—In twenty-one of the thirty cases there is a note of a previous history of well-marked dyspeptic symptoms which had been present for a period varying from a few months to as long as ten years. In twelve cases the symptoms had been present for over one year, in the remainder for shorter periods. In one case the patient had been repeatedly advised by his doctor to seek surgical treatment. Several of the cases illustrated the possibility of an ulcer being "latent" until perforation occurs; in two there was a definite statement that no dyspeptic symptoms had ever been experienced.

Of the symptoms complained of, pain in the upper part of the abdomen, usually related to the taking of food, was the most common. In several cases the pain presented no definite relationship to meals. It may be noted that the time of onset of the pain after a meal could not be taken as a certain guide to the site of the ulcer; in one case of duodenal ulcer the pain occurred as early as half an hour after food. Vomiting was sometimes present, but frequently absent. In only three of the cases, all gastric, was there a history of definite hæmatemesis; in one case it had occurred on the day before perforation.

Premonitory Signs of Perforation and Factors Determining its Occurrence.—In nine of the cases there was a definite history that the symptoms of indigestion had been more pronounced during the few days before perforation took place. Thus we find that one man had been three days off work during the previous week, another had consulted his doctor on the evening before on account of the acuteness of his pain, a female patient had had hæmatemesis on the day before, while another woman stated that she had been able to take very little food during the last three weeks because of the severity of her symptoms. Many of these patients were definite about the fact that this exacerbation was more severe than any they had previously experienced, and it would seem that such a marked aggravation of symptoms does constitute a warning that the ulcer is in an actively spreading condition and is about to perforate the wall of the stomach or duodenum. The presence of such a herald of perforation was referred to and emphasised by Mr. Miles in a paper published in this *Journal* in 1906. In the report of the Collected Cases, it was mentioned with the remark that "no stress can be laid upon this point, as similar exacerbations had frequently been experienced apart from perforation." As indicated above, many of the patients in the present series were quite definite in stating that the pain immediately before perforation was much worse than any they had previously experienced. I am convinced that if this point had been more carefully inquired into, the presence of such a distinct severe exacerbation shortly before perforation would have been found to be commonly present. In any case, it is apparent to the surgical mind that patients who suffer from symptoms of the severity referred to would be well advised to seek early surgical treatment.

With regard to the agency determining perforation, no constant factor can be discovered from a review of the present cases. In one instance, the ulcer perforated while the patient was having

his tea; in others, no food had been taken for several hours previously. In another patient, a tramcar driver, the ulcer had perforated while he was on his car, but there was nothing in the appearance of the ulcer in the form of a tear or other irregularity to suggest that the giving way of the ulcer had been due to muscular exertion. In many cases the perforation occurred while the patient was resting.

Signs and Symptoms Following Perforation.—In the majority of cases these conformed to the features usually described. I have found the patient's description of the onset of his symptoms often very helpful in the diagnosis. The sudden onset of the most agonising pain is always the outstanding fact. The patient is so impressed by the terrible nature of the pain that his terror-stricken manner in describing it is very characteristic; he has never experienced anything so unendurable. He usually falls down and writhes on the floor in agony. One patient who perforated at night-time was only able to crawl to her daughter's bedroom. The pain is referred to the upper part of the abdomen, and, though not localised to any one point, usually attains its maximum severity in the region of the ulcer. In a perforated duodenal ulcer the pain will be most severe in the region of the upper part of the right rectus muscle. Vomiting after perforation is a sign of little value; it sometimes occurs after both gastric and duodenal perforation, but is frequently absent. It was noted in the Collected Cases that prolonged or repeated vomiting is a symptom of grave significance. This is borne out by one of the present cases, a girl of 20, who perforated half an hour after breakfast, and who vomited repeatedly afterwards; operation was performed six hours after perforation, and gastric ulcer found about the size of a shilling; food particles had escaped through the perforation and were free in the peritoneal cavity. She died in twenty-four hours, never having rallied from the initial shock.

In the first few hours after perforation the patient usually presents distinct signs of shock; the surface is pale and cold, and the temperature is frequently subnormal. It is a remarkable fact that, in spite of the intense pain and the shock, the pulse shows very little alteration, either in volume or in frequency. In seven patients presenting signs of shock, as indicated especially by a subnormal temperature, the pulse-rate varied from 64 to 96. This fact becomes of great importance in the diagnosis. The medical man may very well under-estimate the seriousness of the condition if he lays undue stress on the state of the pulse. After

infection of the peritoneum begins to manifest itself the pulse increases in rate and deteriorates in quality; in two cases with fatal peritonitis we find a pulse of 120.

It was pointed out by Mr. Miles in the paper mentioned above that in the majority of cases of perforated ulcer a definite stage of reaction makes its appearance after the first few hours. The pain diminishes in severity, the temperature rises to normal or above, and the patient both looks and feels better. This temporary improvement is most likely to be explained by the rapid outpouring of a peritoneal exudate which serves to dilute the extravasated gastric contents which are so intensely irritating to the peritoneum. It is another feature in these cases which may be misleading. In the present cases quite a number arrived at the hospital during the stage of reaction. Eleven of the patients sent in during the first twelve hours showed a temperature of 99° F. and over; in six cases the temperature was 100° or over. The highest temperature noted was 101·4° F. in a female patient whose ulcer had perforated five to six hours previously. This elevation of temperature may lead to simulation of acute inflammatory conditions, such as appendicitis, cholecystitis, and the like. It should be emphasised that too much importance cannot be attached to either the temperature or the pulse in the diagnosis of perforated ulcer.

This period of reaction is soon followed by the onset of the signs of general peritonitis.

Examination of the Abdomen.—The most striking feature in cases of perforation is the extreme degree of abdominal rigidity. On inspection of the abdomen the rigidity is apparent at once; the tense attitude of the whole body is most characteristic. The abdominal wall and the diaphragm remain immobile, the respiratory movements being carried out mainly by the thoracic muscles. When the hand is placed on the abdomen the degree of rigidity is astounding; it is no exaggeration to speak of the consistence of the abdominal wall as "board-like." This rigidity of the abdominal muscles is general, affecting the whole anterior abdominal wall, and is accompanied by general tenderness. Both tenderness and rigidity are most marked in the upper part of the abdomen, and serve, more or less, as guides to the position of the ulcer. In ulcers in the region of the pylorus the tenderness and rigidity are most marked over the upper part of the right rectus. I have not found it possible to tell from this examination as to whether the ulcer is on the duodenal side of the pylorus or on the pylorus itself. When the ulcer is situated on the body of the

stomach, the tenderness and rigidity are usually most marked to the left of the middle line. It was noted by Mr. Miles and mentioned also in the Collected Cases that the tenderness is sometimes most marked in the right iliac fossa, so that a diagnosis of acute appendicitis is first made. I find that in two of the present cases the incision was made first over the appendix. Curiously enough, both ulcers were gastric, one being situated on the pylorus and one on the lesser curvature. The explanation of the unusual site of the tenderness in these cases is that the exudate, arising first from the peritoneum in the neighbourhood of the ulcer, trickles down the line of the ascending colon to the right iliac fossa and causes irritation of the parietal peritoneum in that region. This would seem more likely to occur in duodenal cases.

Alteration in the superficial liver dulness is a sign of little value in the diagnosis. It is usual at the operation to find free gas in the peritoneal cavity which has escaped through the perforation. In some cases this is present in sufficient quantity to cause a diminution or complete absence of the superficial liver dulness. It should be kept in mind that the same sign may be produced by a distended transverse colon or by an upward displacement of the liver by distended intestine. In some of the present cases there was complete absence of the liver dulness, but in many the dulness was of normal extent.

The clinical features which I have found of most value are the history of the sudden onset of excruciating pain, the general appearance of the patient, and, of greatest importance, the marked rigidity of the upper part of the abdominal wall. It will be found that even in the stage of reaction the rigidity still persists and serves in most cases to render the diagnosis clear.

Operation.—In nearly all the cases the anæsthesia was induced with chloroform and continued by ether administered by the open method. Chloroform is given until the abdomen is opened and ether is then substituted. I have found this method very safe and satisfactory, even if, as happened in a number of instances, the anæsthetist has had a comparatively limited experience. It is sometimes contended that ether does not permit of sufficient relaxation of the abdominal muscles in operations in the upper abdomen and thus interferes with the operative procedures. If the anæsthetic is given in the manner described, no such difficulty will be met with. Ether is so much the safer drug in inexperienced hands that under present conditions it should be preferred to chloroform wherever possible. I have seen no after-complications which could be referred to the anæsthetic.

A mid-line incision above the umbilicus was employed in all cases. I have never experienced any great difficulty in reaching the ulcer from such an incision. It is frequently impossible to be certain as to the exact site of an ulcer, so that a mid-line incision may be preferred to one through either rectus in that it gives good access to an ulcer in any position; an incision at one side may be inconvenient should the ulcer be found in an unexpected situation. It is of value in a doubtful case to begin by making a small mid-line incision a short distance above the symphysis pubis. The recognition of the nature of the peritoneal exudate in most cases clears up the diagnosis at once and the suprapubic incision is utilised afterwards for drainage of the pelvis.

The peritoneal exudate in most cases was of a slightly turbid serous character. The quantity varies very much and does not depend entirely on the time which has elapsed since perforation or on the size of the opening. In similar cases operated on within a few hours of perforation the exudate in one case would be comparatively scanty, in another it would be profuse. The rapidity with which the exudate is poured out in some cases is remarkable. The fluid tends to become more turbid with the passage of time and in long-standing cases is frequently purulent. Definite solid food particles were found in the exudate in only one case; curdled milk was present in another; in a third, whisky was present in abundance, the peritoneal cavity smelling strongly of the stimulant. It may be noted that the first two cases had a fatal termination, while the third recovered. It can hardly be argued from this scanty evidence that whisky is to be recommended as an antiseptic for the peritoneal cavity!

In the majority of cases the perforation was small in size and very little of the stomach or duodenal contents had escaped into the peritoneal cavity. The shape of the opening was almost always circular or ovoid. In twenty-two out of the thirty cases it varied in size from that of a pin-head to the size of a pea. In the remaining eight cases the perforation was described as large, varying from the size of a threepenny to that of a shilling; of these six were gastric and two duodenal. Mr. Miles, in the paper previously referred to, noted that where the perforation was large the patient generally succumbed. This observation is supported by the present series. In the eight cases of large perforations, no less than five were fatal; four of these were gastric and one duodenal. A similar conclusion was arrived at in the report on the Collected Cases—where the perforation is large the gravity of the condition is much increased.

In the majority of the present cases there was a well-marked ring of induration around the perforation. This is usually regarded as due to fibrous tissue and an indication of the chronic nature of the ulcer. Moynihan states that it is not present on post-mortem examination; he regards it, therefore, not as evidence of the chronicity of the ulcer but as mainly due to œdema. Old-standing adhesions were not present in the region of the ulcer in any of the cases, though in one or two the perforation was found to be partially plugged by a recent omental adhesion.

Site of the Ulcer.—In all the twenty cases of perforated gastric ulcer the perforation was situated on the anterior surface of the stomach. Ten were found on the anterior surface of the pylorus, eight were close to the lesser curvature, six of these being towards the pyloric end and two at the cardiac end; one occurred on the body of the stomach, and in one case there is no record as to the exact position. This conforms to the usual findings. In the Collected Cases, out of 209 perforations on the anterior surface of the stomach 116 were in the neighbourhood of the pylorus, fifty-four about the middle of the lesser curvature, and thirty-seven towards the cardiac end. In the present series of ten duodenal cases the ulcer was close to the pylorus in seven and in only three was it more than half an inch from the gastric orifice; in all cases again the ulcer was on the anterior wall. No case of multiple perforation was met with in the series.

Closure of the Perforation.—In all cases the ulcer has been closed in the first instance by the introduction of a through-and-through suture of catgut inserted some little distance away from the margin of the ulcer. Unless a good bite of the stomach or duodenal wall is taken the stitch is apt to tear out of the friable margin of the ulcer. This stitch is then buried by a double layer of Lembert sutures of silk. These are inserted in the long axis of the viscus. It is found that the infolding of the stomach or duodenal wall is much easier if this line is taken than if the sutures are introduced in the transverse direction and less deformity of the organ is produced. Occasionally an omental graft has been added if there has been any doubt as to the security of the suturing. In no case has a gastric or duodenal fistula occurred.

Cleansing of Peritoneal Cavity.—The method adopted has been that of mopping up the excess of exudate in the region of the ulcer with gauze swabs. It has been pointed out by Moynihan that the peritoneal exudate in these cases is not only frequently sterile but is actively antibacterial; therefore, little good and

possibly harm may result from its removal by the methods of irrigation formerly employed. In the Collected Cases it was found that the mortality was less in cases in which swabbing was employed than in those where irrigation was used. It must be admitted that the former method has been used mainly in recent years and the cases have had the advantage of the Fowler position and probably also, in many instances, of an earlier operation, yet the feeling persists that swabbing is the better method. One sees so many instances of what Nature may achieve in the peritoneal cavity without assistance other than that of drainage that the desire remains to cause as little disturbance as possible and to leave the peritoneum to cope with any infection that may be present.

Drainage.—Two of the present series of cases impressed upon me the necessity for free drainage of the abdomen. Moynihan takes the view that drainage of the general peritoneal cavity is "physically and physiologically impossible," and holds that drainage of the abdomen is rarely required. Being impressed by the opinion of Moynihan on this subject, in one of the earlier cases in which perforation had occurred three to four hours before operation and in which the perforation was small, I thought it safe to close the abdomen after having cleansed the peritoneum around the ulcer. This patient developed a left-sided empyema, from which she recovered only after a protracted convalescence. She has enjoyed good health since. The second case had also been perforated only for a short time, and there was very little contamination of the peritoneum; a tube was introduced locally but drainage of the pelvis was thought unnecessary. The patient did well for a week or so and then commenced to go downhill. Signs of peritonitis appeared in the lower abdomen, and on opening under local anæsthesia a large quantity of pus was found in the pelvis. This patient died of general peritonitis. The exudate in this case had passed down the line of the ascending colon and infected the pelvis. I am convinced that a pelvic drain at the original operation would have saved the patient. My procedure since has been to drain the abdomen with two glass tubes; one passes into the pouch of Douglas from a mid-line incision above the symphysis pubis, the other into the right or left kidney pouch according to the site of the ulcer. I have seen no harm result from the use of glass tubes, and drainage is much more satisfactory than with those of rubber.

In the case of an ulcer in the region of the pylorus or in the

duodenum there may be considerable narrowing of the lumen after the ulcer has been closed and infolded. To provide for the onward passage of the gastric contents it may be considered necessary to perform a gastro-jejunostomy. An additional incentive to this procedure is the recognised fact that most cases of duodenal ulcer—and probably of gastric ulcer also—undergo healing after its performance. This was borne out by the case of perforated duodenal ulcer in a female patient to which I have previously referred. I operated again recently for a peptic ulcer of the jejunum, and at this second operation the duodenal ulcer was found to be quite healed. The hour-glass contraction of the stomach which was present at the first operation still persisted, but the ulcer which had given rise to the contraction was also apparently healed. At the same time it should be kept in mind that a patient who has a perforation of a viscus is in a condition of great gravity, and is not in a fit state to withstand any prolonged operative procedure. Gastro-enterostomy was considered necessary in six of the present cases. Four of these made excellent recoveries. Two patients died, one on the day after operation, and the other on the thirteenth day from an acute lobar pneumonia. In such a limited number of cases it is difficult to say that the addition of the anastomosis increased the mortality, but the impression left is that one should avoid this addition where possible. It is remarkable the degree to which the pylorus can be narrowed without any apparent interference with the transmission of the stomach contents. I have had the feeling on several occasions that it might be necessary to re-open the abdomen for the performance of a gastro-enterostomy, but the second laparotomy has never been required.

Immediate Results.—Of the thirty cases, twenty-one recovered and nine died. One of the fatal cases was obviously moribund at the time of operation. His history indicated that perforation had occurred a fortnight before admission; the infection had remained localised until about twenty-four hours previously, when a collection of fluid had apparently burst into the general peritoneal cavity. It was thought right that he should have any slight chance of recovery there might be, and drainage tubes were introduced under local anæsthesia, though with very little hope of doing good. No attempt was made to search for the ulcer. As one expected, this patient died a few hours after operation. Of the remaining eight fatal cases, three died within thirty-six hours of the operation; two of these have been noted as having

large perforations. Of the remaining five, one died of pneumonia, two of general peritonitis, and in two there is no record as to the cause of death. It is somewhat difficult to determine the bearing of the time factor in the fatal cases; most of these patients were too ill to permit of much cross-examination, and the records are somewhat defective on this point. It may be noted, however, that only two of the nine cases are recorded as having been sent to hospital within twelve hours of the time of perforation. It is satisfactory to find that the majority of the patients who recovered were sent into hospital within that period. Of the twenty-one cases, seventeen are recorded as having been sent in within twelve hours. One patient who recovered was operated on forty-four hours after perforation, and one, a man of 64, seventeen hours after. It is apparent that most practitioners are fully alive to the urgency of this condition, and, in spite of scarcity of doctors and other difficulties, cases are usually sent into hospital very promptly. It may be mentioned in this connection that the six cases on whom I operated in Leith Hospital all recovered.

The present series is much too small to be of any value in drawing conclusions as to the mortality of this emergency, but it may, perhaps, be of some interest, in view of the present circumstances of the profession, to compare the results in these cases with those obtained in the Collected Cases. In the eight years from 1896 to 1903 the mortality in cases of perforated gastric ulcer was 61·3 per cent.; in the five years from 1904 to 1908 it was 38·2 per cent.; from 1909 to 1913 it was 35·3 per cent. In cases of perforated duodenal ulcer the mortality was much the same during these periods. In the present cases there were nine deaths in thirty, which gives a mortality of 30 per cent.

With regard to ultimate results, some of the cases are too recent for a report at this stage to be of great value. In addition, at the present time it is extremely difficult to keep in touch with hospital patients; men are called up for military service and women have frequently gone to some other district for munition work or other special service. I have obtained reports from fifteen patients and these suffice to show that in a good percentage of cases the perforated ulcer undergoes complete healing; many of the patients have enjoyed excellent health since the operation. One man is reported by his parents to have been in France for a year; they state that he was home last October looking in "the pink of condition," and making no complaint of gastric or any other symptoms.

CEREBRO-SPINAL FEVER.

By P. W. MACLAGAN, M.D.

IV.—Treatment.

Cases of cerebro-spinal fever die from one of two causes: (1) The severity of the infection may be so great that the defensive system of the body is unable to respond adequately. (2) Interference with the circulation of the cerebro-spinal fluid, or other result of the incomplete resolution of the inflammatory products. With very few exceptions, this means the establishment of internal hydrocephalus, as a result of adhesions about the base of the brain.

To combat the first condition, we must assist the formation of antibodies in the blood, or, perhaps, even supply these until there is an adequate response to the infection, and we must also encourage the elimination of toxins.

In the second place, we must provide sufficient drainage of the subarachnoid space to prevent the formation and to promote the absorption of adhesions.

Several workers during the epidemic of 1915-1916 have been gravely disappointed with the results of *serum treatment*, and are inclined to condemn it from observations on comparatively small series of cases. In my own series of over 400 cases in which treatment with serum has been carefully carried out and which apparently includes a high percentage of fulminant cases, the mortality has been 34 to 35 per cent., and I think that with improved methods of preparation of the serum still more encouraging figures will be obtained. Discouragement at the apparent failure of serum treatment has led to the adoption of other methods.

Two or three observers rely upon frequent puncture and drainage of the subarachnoid space. These workers regard cerebro-spinal fever as an infection confined to the central nervous system and regard any general infection as a leakage of organism of their toxins through the meninges. I am unable to agree with this theory, and cannot consider that simple drainage of the subarachnoid space covers the indications for treatment in this disease. It is true that the mortality figures published by these workers show an improvement on previous epidemics, almost as great as serum treatment does, but with Sophian's and Dopter's figures before us, the latter appears to offer more hope of success.

Others, taking the analogy of the treatment of syphilis as a guide, are attempting to combat the infection by means of intravenous injections of soamin, sodium aminophenylarsonate. This method of treatment has not produced encouraging results, and the dangers of soamin administration are well known. One other drug has been largely employed as a curative agent—hexamethylene tetramin. This is one of the few drugs which is able to pass through the normal choroid gland into the cerebro-spinal fluid. After its administration formalin is easily recognised in the fluid in comparatively large quantities, and attempts to cultivate the meningococcus from such fluids are, as a rule, futile. While it does not appear to have any great effect on the course of the disease, it may have considerable effect in preventing relapses, and may well be given as a routine measure.

Method of Serum Administration and Dosage.—Flexner introduced the intrathecal route of administration in 1906. He was led to adopt this method because of the following considerations:—Apparently the main site of infection was the meninges, and by injecting the serum subdurally it was brought into closest contact with the infecting organism. If it were injected into the blood-stream, only slowly and in great dilution would it reach the meninges, and there was some risk of part of it being excreted during the process. Also the antibodies in Flexner's original serum were largely opsonins, and these could best exert their action on the meningococcus when introduced in this way. Flexner, therefore, removed as much of the excess cerebro-spinal fluid as possible, and replaced this with serum injected slowly through a syringe. It was soon noted that this method had several grave disadvantages. Immediately after the injection the symptoms of the disease were frequently much aggravated, headache became more violent, the temperature rose, and there was even dangerous respiratory embarrassment from interference with the respiratory centre. It was suggested that these unfortunate occurrences were due to the injection of cold serum, but they were still observed after the serum had been warmed. It was then recognised that they were due to the sudden re-establishment of the increased intrathecal pressure which had been relieved by lumbar puncture. This led Sophian to devise new methods of controlling the dosage by stopping the injection before the pressure regained its ordinary level. It was found that alarming symptoms occurred although the pressure remained lower; it was also noted that a larger volume of serum could be injected

than the fluid removed, before the original pressure was regained. This he explained as due to the local distension of the spinal theca. Sophian then began an extremely interesting and painstaking series of observations on the fall of blood-pressure during the evacuation of the fluid and the serum injection. He noted that there was a constant fall of a few millimetres pressure during the removal of the fluid, and that a further and greater fall occurred during the injection of the serum. As the result of a very large series of observations he arbitrarily fixed the dosage as the amount of serum required to be slowly injected to cause a fall of 10 mm. of mercury in the adult and 5 mm. in the child. This fixed the dose at quantities varying from 3 c.c. in a child to 20 c.c. in an adult, the injection being made by the gravity method at such a rate as to inject 15 c.c. in ten minutes. While such a method of controlling the dosage may be criticised, Sophian was undoubtedly correct in advocating smaller doses, and the result was immediately seen in the lowered mortality rate and in the improved condition of the patients after the injection. With the larger doses at first employed, the shock to the nervous system and the danger of interference with the vital centres often helped to produce a fatal result.

With regard to the frequency of administration, Sophian recommends daily, in very acute cases, more frequent injections, to be continued until there is marked amelioration of the symptoms and the cerebro-spinal fluid is clear. Netter and Debre, working on the Paris epidemic of 1910, recommend larger doses of serum and daily injections for the first four days, followed by an interval of four days, and then another course of injections if necessary. They insist on careful daily examination of the cerebro-spinal fluid, and continuance of the injections as long as any organism can be seen, even in spite of marked improvement in the symptoms.

In my series of cases the larger dosage at first employed undoubtedly caused much shock and aggravation of the symptoms without any corresponding benefit, and the smaller dosage so strongly recommended by Sophian has proved much more efficacious. The method of controlling the dosage by estimation of the fall in blood-pressure is cumbersome, and, I think, unnecessary. In adults a dose of from 20 to 30 c.c. is most efficient and produces little or no ill effect. As long as no estimate of the amount of antitoxin present in the serum can be obtained, it is necessary to fix the dosage as the result of clinical observation.

Before the administration of the serum the subarachnoid space

is drained as completely as possible by means of a lumbar puncture, and the serum is introduced by the gravity method with as low a head of pressure as possible, usually 3 or 4 ins. is sufficient. There appears to be no risk attached to the removal of large quantities of cerebro-spinal fluid; up to 120 c.c. have commonly been removed, and the usual amount is about 60 c.c. This operation is performed daily until there is great improvement in the symptoms and until the cerebro-spinal fluid is clear, or until six or seven doses have been given.

After this period there appears to be considerable risk of sudden respiratory failure attached to the injection of serum, no matter how carefully performed, and also a certain risk of the occurrence of the phenomenon of anaphylaxis. These risks are hardly worth running, as by this time the acuteness of the infection is probably overcome, and the patient is producing sufficient antibodies of his own. The main indication now is to prevent the establishment of an internal hydrocephalus, and this is best met by frequent simple lumbar puncture. Accumulation of cerebro-spinal fluid must be prevented until such time as the normal formation and absorption are re-established. The indications for lumbar puncture at this stage are headache, rise of temperature, and vomiting. These symptoms are at once relieved by simple lumbar puncture, so long as the communication between the interventricular system and the subarachnoid space remains patent.

Believing strongly as I do in the part played by a general infection in cerebro-spinal fever, I also inject about 30 c.c. serum intramuscularly, and believe that the results obtained justify this procedure. With the exception of those fulminant cases, in which fatal lesions of the adrenal glands are produced before treatment can have any effect, no case now dies from the severity of the infectious process. Death is either due to a complicating pneumonia, etc., or after a more or less prolonged illness to the establishment of internal hydrocephalus. The result is, I think, certainly due to the treatment employed, and if a serum could be produced of a higher antitoxic content and more specific to the various types of meningococcus met with in this epidemic, we might expect even greater results.

Recently in fulminating cases I have been employing intramuscular injections of liq. adrenalin hydrochlor., 1 to 1000, in doses of 10 minims. This is an attempt to replace the internal secretion of the damaged adrenal medulla, in the hope that it may be able to resume its function. This appears to be a promising

line of treatment, as in several extremely severe cases the pulse at the wrist has returned, and two or three of my latest cases of this type have recovered. These were all cases which one would have thought to be of an inevitably fatal type. In all fulminating cases, with an extensive purpuric rash and failure of the peripheral circulation, the intramuscular injection of adrenalin is worthy of trial.

In the type of case where the cerebro-spinal fluid becomes so thick and purulent that it will not flow through even the largest lumbar puncture needle, the manner of treatment must be modified. As only small quantities of fluid can be abstracted, and as the injection of serum into the subarachnoid space under pressure is highly dangerous, we must be content with the introduction of small doses more frequently, combined with the intramuscular injection. In this way we hope to render the exudate more fluid, but the treatment of these cases is very discouraging.

Vaccine Treatment.—In subacute and chronic cases, in which there is considerable attenuated and lingering infection, treatment by means of vaccines is of considerable value. The vaccine should be prepared from the patient's own organism or from a similar type, and the initial dose may be 50 to 100 millions. The dose may be repeated and increased every three to five days, depending on the amount of reaction produced. The usual reaction consists in slight headache and rise of temperature. If the initial dose is too large or the increase is too rapid, a more marked reaction is produced. The headache is severe, the rise of temperature much more marked, and may be accompanied by rigors. In this case no increase should be made in the succeeding doses, or it may be decreased.

In addition to specific treatment, we must treat our cases on ordinary medical principles. As great as possible elimination of toxins must be secured by obtaining regular action of the bowels, and the vascular system should be flushed by the ingestion of large quantities of fluid, by the mouth, by rectal salines, or by the subcutaneous injection of normal saline. The effects of the toxæmia on the cardiac muscle must be watched, and the administration of cardiac tonics, digitalis or strophanthus, employed when necessary. The patient must be kept strictly in bed until convalescence is well established. It is a good rule not to allow a patient to get up until his temperature has been normal for fourteen days and Kernig's sign is no longer present. For the last few days of this period he may be allowed to be propped up

on pillows. The diet should consist of fluids during the acute stages, but with the establishment of convalescence may be rapidly increased.

The appetite during convalescence, and even in cases where there is considerable hydrocephalus, is enormous, and must be carefully controlled. The loss in weight is rapidly regained. As the bowels are usually constipated, regular use of laxatives must be employed. Administration of calomel and frequent use of enemata best meet this indication.

Retention of urine must be carefully watched for, even in incontinent cases, and may require the use of the catheter. Hot fomentations, a morphia suppository, and a simple enema will often relieve this condition satisfactorily.

Severe headaches and restlessness will often require to be relieved. Bromide and chloral, suphonal or veronal may be of value in mild cases, but very frequently morphia is necessary. It may be freely used without danger or the establishment of the morphia habit. The use of an ice helmet may give relief in the same circumstances.

The use of urotropin (hexamin) as a routine measure has already been mentioned. The dose should be about 15 grs. thrice daily in a large quantity of water. During its administration the urine should be carefully watched for evidence of renal irritation.

After the operation of lumbar puncture, local pain in the back may be relieved by hot applications.

During convalescence little treatment is necessary. The patient should be out of doors as much as possible, and should be on a full diet.

Treatment of Complications.—Pneumonia must be treated on ordinary lines, as must pericarditis, if recognised during life.

The treatment of arthritis consists in hot applications to the affected joints, or the application of methyl salicylate. Internal medication is of little value, but the salicylates may be tried. If there is marked effusion or suppuration into any joint, it must be aspirated. Sophian described recovery in suppurative arthritis following the injection of anti-meningococcal serum into the joint cavity, but simple aspiration has been equally successful in my experience.

For complications affecting the special senses, little can be done, and our efforts must be directed to prevention of further involvement of these organs.

Paralyses.—The course of hemi- and monoplegia in cerebro-

spinal fever tends towards recovery in most instances, and the treatment must consist in keeping the affected muscles in the best possible condition until recovery takes place.

Serum Sickness.—The effects of this are, as a rule, transitory, and may be largely prevented in most cases by administration of calcium lactate in 20-gr. doses.

Treatment of Carriers.

During the present epidemic, many efforts have been made to discover a speedy and reliable method of ridding the nasopharynx of the meningococcus. The large number of carriers isolated, and the prolonged period during which some of them "carry" the meningococcus, considerably interferes with military training.

(1) The local application of antiseptics to the nasopharynx, with the object of attacking the organism *in situ.* (2) Active immunisation by vaccine treatment. (3) The introduction of antagonistic organisms into the nasopharynx.

1. The application of antiseptics by means of sprays, douches, or gargles is the most obvious line of treatment. Solutions of potassium permanganate, argyrol, protargol, iodine, hydrogen peroxide, menthol in parolein, have been tried by one or all of these methods. None of these have given satisfaction, and it is doubtful if the period of carrying has been in the least shortened by any of these means. 1-1000 solution of potassium permanganate is most extensively employed and is at least harmless.

2. As the carrier suffers from no general infection, one would hardly expect active immunisation to cure the condition, and this is found to be the case. Recovered cases of cerebro-spinal fever may remain persistent carriers, in spite of the marked immunity reactions which they develop.

3. Implantation of the pneumococcus into the nasopharynx did not result in overgrowing the meningococcus. In the case of those carriers who have come under my care, I have found that the only measure of any value in treatment is the insistance on abundance of fresh air. Carriers should live as much as possible out of doors, and should be provided with a certain amount of work or exercise. This acts in two ways—the general health is improved and the possibilities of reinfection from each other are reduced. Any abnormal condition of the nasopharynx should be treated, and a gargle, douche, or spray of 1-1000 potass. permanganate cannot do harm in any case.

Quite recently Gordon and Flack, at the R. A. M. College, have advised the application of antiseptic solutions in the form of fine droplets floating as a cloud or mist mixed with steam. The spray is generated from an atomiser of the type of the Linger spray, used for disinfecting rooms with formaldehyde vapour. Latterly Gordon has used a more powerful spray of a similar type. The disinfectants used are a 2 per cent. solution of chloramine, and a 1 per cent. solution of zinc sulphate. The first of these proved to be the more powerful in its action on the meningococcus, but it had some disadvantages in practice, as it causes a certain amount of bronchial irritation; zinc sulphate is quite unirritating. The vapour is inhaled vigorously for a period of from five to twenty minutes, and from three inhalations upward are required to free the nasopharynx from the meningococcus, the number depending on the severity of the local infection.

I have used a Linger spray for the purpose of treating patients who remain carriers after an attack of cerebro-spinal fever, but it is much too early to form an opinion as to the efficiency of the treatment from my own observations.

Nurses and attendants in cerebro-spinal fever wards are also undergoing a course of inhalations, in order to prevent any risk of carrying infection.

Mortality.

Of all the infectious diseases, cerebro-spinal fever has the highest mortality-rate. While the proportion of the population attacked during an epidemic is very small, the number of cases which die is very high. In the early epidemics of Europe and America the mortality-rate was from 70 to 90 per cent. or even more. In 1908, when Flexner commenced to treat his cases by the administration of his serum subdurally, there was a marked fall in the proportion of fatal cases. Of 712 cases which he collected, the mortality of those treated without serum amount to 70 to 80 per cent., of those treated with serum 31·4 per cent. Sophian, in a series of 161 cases treated with Flexner's serum, had a mortality rate of 25 per cent. Dopter, during the Paris epidemic of 1910, using a serum prepared from meningococci isolated from his own cases, had a percentage mortality of only 16·44 per cent. in a series of 402 cases. Ker in Edinburgh. and Robb in Belfast, found that the mortality was reduced by more than one half by the use of Flexner's serum.

During the present epidemic, at least in the early stages,

many workers were gravely disappointed with the results of serum treatment, the mortality-rate in some instances being almost as high as in the early epidemics. With improved serum, prepared by using strains of meningococci isolated from cases during the epidemic, much better results are now being obtained. In a series of 329 cases treated by myself, the mortality was 34·5 per cent. The earlier in the course of the illness that specific treatment can be commenced, the lower is the mortality-rate.

The following table, quoted by Flack, is instructive:—

	Cases treated before third day.	Treated after seventh day.
Netter	7·14 per cent.	23·5 per cent.
Dopter	8·20 ,,	24·1 ,,
Flexner	14·9 ,,	36·4 ,,
Flack	9·09 ,,	50·0 ,,

This result is confirmed by my own experience. If one can commence treatment during the first twenty-four hours of the disease, one can confidently expect a favourable result. As each day passed before the administration of serum, so is the gravity of the prognosis increased. Not only is this the case, but the duration of the acute stage of the illness depends on the period of the commencement of treatment. In those cases which are treated within the first twenty-four hours, the duration of this stage is usually three to four days; in cases treated after the third day, ten to twelve days, even if the case progresses favourably. Evidence as to the differences in the mortality-rate, due to the different types of the meningococcus, is at present too inconclusive to be of any value.

Summary.

Cerebro-spinal fever is a specific infectious disease.

The causative organism is the diplococcus intracellularis of Weichselbaum, commonly known as the meningococcus.

This organism is carried in the throats of apparently healthy persons, who are known as "carriers."

An epidemic of cerebro-spinal fever is really an epidemic of meningococcal "carriers," with sporadic cases of the disease.

The original site of the organism in the body is the posterior nasopharynx. From this local seat of infection the meningococcus spreads, *via* the blood-stream, to the leptomeninges of the brain and cord.

Infection of the meninges may not necessarily result from infection by the meningococcus. In about 2 per cent. of cases the initial septicæmia is so severe that the patient succumbs before the lesions of the meninges have time to develop. In these the characteristic lesion is found to consist in a hæmorrhagic inflammation of the adrenal glands, associated with purpura. To combat the great fall in blood-pressure which results, intravenous or intramuscular injection of adrenalin is useful in order to restore the tone of the peripheral circulation.

The signs and symptoms of cerebro-spinal fever are due to the combination of several factors, which are all present to a varying degree in every case of the disease.

1. The general toxæmia, which is common to all infectious diseases.

2. The lesions of the central nervous system and its covering membranes.

3. The presence of certain products of degeneration of the myelin of the nerve fibres, namely cholin and neurin.

All these factors are present in any one case, the varying pictures produced depending on which predominates.

Cases of cerebro-spinal fever may be classified into the following types:—(1) Fulminating type. (2) Ordinary acute type. (3) Suppurative type. (4) Abortive cases. (5) Mild cases. (6) Posterior basic meningitis.

These types can be distinguished both clinically and bacteriologically.

Death may be due to either the severity of the infection or to the establishment of internal hydrocephalus.

Treatment with specific antisera holds out more hope of success than any other line of treatment.

Since the institution of this means of treatment, the mortality-rate of cerebro-spinal fever has fallen from 70 to 90 per cent. to 30 to 40 per cent. The proportion of patients who suffer from permanent and disabling complications has been reduced by an even more remarkable extent.

THE TRAINING OF THE STUDENT OF MEDICINE:

An Inquiry Conducted under the Auspices of the Edinburgh Pathological Club.

XVI.—MEMORANDUM ON THE TEACHING OF MATERIA MEDICA AND THERAPEUTICS.

By Professor Sir THOMAS R. FRASER, M.D.

From the earliest period of medical education, and even before many of the subjects now embraced in medical education had been conceived of, Materia Medica has comprehended the physical, sensory and natural history characteristics of medicinal substances and the use of these substances in disease.

The growth of then existing sciences and the evolution of new sciences, such as those of physiology and pathology, led to much progress and expansion.

At the present time, and during the last half century, Materia Medica has so expanded as to comprehend (*A*) pharmacognosy, pharmacy, and the principles of prescribing; (*B*) pharmacology; and (*C*) therapeutics.

The two former are appropriate for instruction at an early part of medical study, whereas the third is, in most of its aspects, inappropriate until a late period and after knowledge has been acquired of pathology, medicine, and clinical medicine.

Founding upon this conception, a subdivision in education and study seems to be required.

(*A*) Pharmacognosy, Pharmacy, and Prescribing. — These subjects relate to physical properties. They are applications of physics, chemistry, botany, and zoology. They may well be taken at an early period of the curriculum—from the second to the third year. The practical importance of the knowledge embraced in (*A*) is apt to be overlooked. Briefly stated, the want of it would much cripple the practice of medicine. Ignorance, for example, of the physical and chemical conditions and solubility of medicinal substances might, and frequently does, lead to restriction in the selection of the most appropriate remedies in disease, *e.g.* in the uses of guaiacol and its carbonate, of the ethyl and methyl sulphon compounds, of bichromate of potassium, etc.

It has proved a great saving of time to deal with these subjects in a systematised practical form in the class of practical materia medica. A remarkable improvement has taken place, which, for instance, is shown at the Final Professional Examination in the generally satisfactory manner in which prescriptions are written, and in the fuller

knowledge of pharmacognosy and pharmacy now gratifyingly recognisable and in great contrast with the chaos that distinguished the results of instruction formerly obtainable by apprenticeship to druggists and by the desultory and very restricted teaching in the laboratories of dispensaries.

In future, and especially because of the appearance and rapid growth of the biological subjects embraced in materia medica, it is desirable that the time set apart for (*A*) should be extended to the period of one term, with at least fifty meetings, in order that more time may be given to practical instruction and the study of pharmacognosy. Adequate instruction in it as well as in the other subjects embraced in (*A*), however, has been regarded as imperative since the beginning of medical education.

(*B*) PHARMACOLOGY.—Until about half a century ago the subject of pharmacology, on the other hand, was almost unrecognised. Since then it has rapidly grown with the development of chemistry, physiology, and pathology, so that at present its due consideration is hampered in a course of materia medica by the time required for the subjects embraced in (*A*) and (*C*).

Pharmacology deals with the action of medicinal substances in *normal* states of the living organism. The physical and sensory nature of the substances discussed must be realised by the student, and hence the indivisible association of pharmacognosy with pharmacology. If, however, in an enlarged course of (*A*) more were taught than at present of the physical and chemical nature and the sources of medicinal substances, mainly by demonstrations and individual study, only a very cursory reference to them would be required in the course of lectures on materia medica. Time would thus be gained for the much-needed expansion of the instruction in pharmacology. It is desirable that the latter should comprehend practical demonstrations of the more important actions, which would best be given to limited numbers of the class. The number of these actions suitable for demonstration, however, is only a small one. In almost no case could all the pharmacological effects of a single medicinal substance or of a group of such substances be demonstrated, and verbal descriptions would still be required before a true conception of the total multiple action could be realised. This is not merely a matter of scientific importance. In illness, it is often desired to combat a single symptom, but it should be known by the practitioner what other effects the selected substance causes, as these may be injurious and may limit the dosage to an unsatisfactory degree. It is a substance and not a pharmacological or therapeutical effect that is prescribed, and the substance usually produces many effects in addition to the one or even the several that are desired.

Just as it would be undesirable to avoid all reference to pharma-

cognosy, so also to therapeutics. The evidence of the action of many substances is based on the effects observed in disease even more than in healthy conditions. If the former were excluded, the valuable effects, for example, of many antipyretics, antimalarials and diuretics, *e.g.* quinine, diuretine, potassium acetate, salicyl compounds, would require to be ignored in the description of their actions. It is to be remembered also that the dosage of substances is estimated by their effects in disease and thus becomes a therapeutic as well as a pharmacological question.

It is of the highest importance that the subject of therapeutics should not be altogether eliminated from the teaching given in the ordinary systematised class of materia medica. Therapeutics cannot there be fully or elaborately taught, as the curriculum requires the student to attend the class before he has acquired an adequate knowledge of medicine and of pathology. Such therapeutics as is taught, however, requires that the teacher himself should have knowledge of practical medicine. He should be in personal contact with patients, while at the same time his thoughts and energies should not be diverted from his subject by the exactions of private practice. A limited number of medical beds should be assigned to his charge, if possible in a hospital in which clinical instruction is given. His teaching of pharmacology would thus be rendered more valuable to his students, as he would have the opportunity of keeping in touch with the requirements of practical medicine, by engaging in actual observation and experiment in the treatment of disease by medicinal substances, and of thus rendering his instruction in pharmacology more fruitful.

The Universities Commission of 1889 fixed the salary of the future Professor of Materia Medica at a lower sum than the salaries of the Professors of Physiology and Pathology, on the understanding that, conforming with the traditions of the Chair, he would engage in outside remunerative work. As in future his appointment would debar him from such additional professional work, it is reasonable that the salary should be the same in amount as the salaries of the Professors of Physiology and Pathology.

(*C*) THERAPEUTICS.—The aim and object of (*A*) and (*B*) is to improve the means of treating disease by medicinal substances and agencies, an object which is dealt with more directly in the word therapeutics. Probably the growing needs of these subjects might have been overtaken without the institution of special new professorships.

A few years ago, when the conditions of tenure of a new Chair of Clinical Medicine were being considered by a Joint Committee of the University Court and the Managers of the Royal Infirmary, a proposal was made, and appeared to meet with approval, to require the occupant

of the Chair to devote his whole time to the treatment and teaching and investigation of disease. This proposal, however, was afterwards departed from, and no special conditions were attached to the new Chair excepting a distinctive name and a salary somewhat larger than that of the other professors and senior lecturers in clinical medicine. As originally suggested, the new professor, dealing unavoidably with the treatment of disease, would necessarily have had much of his time, if not the greater part of it, occupied with therapeutics. To supply these unattained requirements, and thereby to provide for the greatest existing want in our system of medical progress and research, it is desirable that a Chair of Applied Therapeutics should now be established, with the following duties and conditions of tenure :—

1. Systematic or didactic instruction on the remedies and remedial measures for treating forms of disease such as pyrexia, inflammation, rheumatism, rheumatic fever, neuralgia, insomnia. This instruction could even now be graphically and vividly imparted by such means as the examination at the bedside of the patient, before and during and at the termination of the treatment of many diseases, such as those of the heart and blood, and of pneumonia, pleurisy, myxœdema, syphilis, anæmia, and the other diseases above mentioned.

2. Instruction at the bedside on the therapeutic effects of individual remedies or of combinations of them, with explanations of the observed effects, based, as far as possible, on their pharmacological effects.

3. Original observation on new substances or methods of treatment on patients, also based, as far as possible, on their pharmacological effects.

4. If physical therapeutics be not included, probably the systematic lecture part of the course could be overtaken in about twelve lectures, for, of course, the teacher would assume that the students are already acquainted with pharmacology. The professor should take a share in the routine teaching of clinical medicine with the other professors and the senior lecturers.

5. In addition to routine bedside instruction, the Professor of Therapeutics should engage in original investigations relating to the treatment of disease, and in their superintendence and direction by others.

For these purposes he should be provided not only with patients but also with assistants, laboratory accommodation, and the newer instruments required in the modern methods of advancing knowledge of the abnormal conditions of patients and the effects of treatment.

These duties would involve the expenditure of much time, and should, indeed, occupy the chief thoughts and interests and ambitions of the Professor of Therapeutics.

6. If this be admitted and considered desirable, private practice should not be engaged in, nor any outside professional or non-professional work requiring more than a trivial expenditure of time during

academic hours. On appointment, the professor should be a man of from 30 to 40 years of age, and should receive a salary of at least £1000 a year.

7. The subject of the professorship should be taught in the final year of study and should be examined on at the Final Professional Examination.

8. Much care would be required to find a man with the requisite scientific and clinical training; knowledge of pharmacology, chemistry and pathology, beyond that usually possessed by undergraduates in medicine; originality of outlook; and power of inspiring others. To obtain a man with these qualifications would probably be attended with exceptional difficulties during the continuance of the war.

(The substance of the above memorandum was submitted to the Faculty of Medicine on the 6th of December 1917, and subsequently to the members of the University Court. These three departments ((*A*), (*B*), and (*C*)) constitute a school of materia medica and therapeutics. Advantage would be derived were it possible to appoint the holder of (*B*) or (*C*) a director of the school. I fear this cannot at present be accomplished. In any event, it is hoped that the harmony of objects will lead to co-operation in work so that a substance found by pharmacology to possess probable therapeutic value may in patients be investigated by the Professor of Therapeutics; while pharmacological incompleteness and doubts may be referred by him to the Professor of Pharmacology for further examination and solution.)

XVII.—THE TEACHING OF MATERIA MEDICA AND THERAPEUTICS.

By Professor C. R. MARSHALL, University of St. Andrews.

The knowledge of remedial measures required by medical students should be limited to that which is likely to be of service in the treatment of disease. As regards drugs, the student should know (1) their names and the forms in which they may be administered, and as much of their physical and chemical characters as is necessary to employ them with advantage; (2) their action, and, as far as possible, their mode of action on healthy and diseased tissues and on the causal factors of disease; (3) the diseases and pathological conditions in which experience and experiment have proved them to be beneficial, and the doses in which they have been found to be of service. He should not be required to learn the sources of drugs, whether chemical or botanical, or the botanical classification and description of crude drugs of vegetable origin. Nor is it necessary that he should be acquainted with those pharmacological actions of individual drugs which have no bearing upon their toxicology or therapeutics.

The appropriate place for materia medica in the present medical curriculum is in the third year of study. The greater part of the course should be devoted to the pharmacological actions of remedies and their bearing on diseased processes, in order to lay a scientific foundation for a rational therapeutics. At this time the student has passed through the courses of chemistry and physiology, which are the corner-stones of pharmacology, and he is presumably studying pathology, which is equally important for an accurate conception of the actions of drugs in their relation to medicine. Indeed, from a pharmacological point of view it is also desirable that pathology, including bacteriology, should precede pharmacology, but as the two subjects can be made mutually helpful, and may, together, be made the foundation for the subsequent years of study, it is more profitable to study them concurrently. These two subjects should afford the main courses of the third year.

Since at this time the student's knowledge of the practical parts of medicine can be only very meagre, it is obviously impossible to teach therapeutics in any comprehensive sense. An enumeration of the diseases for which any particular drug has been given is of little value, and at this stage the teaching of therapeutics should be limited to the principles of treatment and, with few exceptions, to the deductions which can be drawn from the pharmacological action of a drug to its beneficial influence in morbid processes. Similarly, while it is desirable that the non-medicinal measures employed in therapeutics should be briefly described and considered from a physiological point of view, their applications can only be stated in broad outlines. To complete the student's training in therapeutics a briefer supplementary course (or courses) should be given in the final year. It might take the converse form of considering pathological conditions and the best means of combating them. Naturally, most of the student's therapeutic training should be done at the bedside, but in many schools this training seems to be inadequate. It is not sufficient to state that a particular drug or formula is beneficial in a given condition. A reasoned statement of its value, or, in the case of a combination of remedies, of the value of the individual components, should be offered, and the student taught to watch the effect of the treatment on the course of the disease. Brief courses of a few lectures on dietetics, climatology, and non-medicinal methods in general, as far as possible with demonstrations, should be given at this stage.

In short, the training of the medical student in materia medica and therapeutics should be as utilitarian as is possible with the laying of a scientific basis for the eventual treatment of disease. He should, however, be taught current opinion on the mode of action of drugs in general, and principles such as underlie the relation between chemical constitution and pharmacological action, in order that he may be able

to discriminate between the probably good and the probably bad remedies in the specious advertisements of the day. But pharmacology as a branch of biology cannot receive adequate treatment in the ordinary medical curriculum without unduly encroaching on other subjects, and as it is very desirable for many reasons that it should be taught, it might well be included as a subject for the degrees in science.

XVIII.—TEACHING: WITH SPECIAL REFERENCE TO MATERIA MEDICA.

By WILLIAM C. SILLAR, Lecturer on Experimental Pharmacology, University of Edinburgh.

THE word teaching has been chosen as the title of this contribution to the discussion on medical education, because the determination of principles must precede the arrangement of details; and the adjustment of the latter is a less arduous task when the former meets with general agreement. What measure of agreement, then, exists with regard to the answers which ought to be given to the three questions—First, What is teaching? second, Is it an important function in the University? and third, To what extent does it exist to-day in our medical curriculum?

To the first question, concerning the nature of teaching, we may say that the imparting, not of information, but of instruction, is the essence of teaching, and that this imparting of instruction is education or the development of certain powers of the mind of the taught. The powers which, during the medical curriculum, require most particularly to be developed, or produced if they are not already in existence, are (*a*) the power of orderly arrangement of the facts which are being acquired (which facts, by the way, should be supplied in the text-book written by the teacher); (*b*) the sense of proportion whereby the more important can be discriminated from the less important, which sense is most readily inculcated by means of the lecture; (*c*) the power of observing with attention things and processes; and (*d*) the power of recording the results of these observations in accurate language, and pictorially or graphically where these methods are possible. The instruments for the two last are the practical and tutorial classes.

To the second question, regarding the importance of teaching, my answer would be that it is impossible to exaggerate its importance; and to the third question, dealing with the present-day existence of the function in the medical curriculum, I suggest, with the expectation of indignant denials, that it is very little in evidence.

Thus the text-book (not a work of reference) with those facts and explanations which alone are to be permanently remembered is not yet issued to every class so as to obviate the distracting exercise of

excessive note-taking. The lecture is still given to all, irrespective of individual capacity and attainment, and even the practical class is attended by those who do not understand why they are performing the tasks allotted to them, and believe that their time is being wasted by the unnecessary repetition of unnecessary and non-educational processes.

The possession of a good foundation is an advantage when we wish to erect with confidence and certainty an edifice which shall be stable, and to which can be added superstructures; but our experience is that the foundation has not been well and truly laid, and any proposal to lighten the superstructure by placing some of it among the foundations appears to be an imperfect method of meeting a difficulty; or, if we use a figure which has been frequently employed, and discuss the problem of pouring a quart of fluid into a pint bottle, the problem is not solved satisfactorily by boring a hole in the bottom of the bottle, although, no doubt, to the superficial observer there will be all the appearance of the reception of the extra fluid. A more reasonable remedy is to organise an alternative, voluntary, lengthened curriculum.

The foundation, laid at school, which we require is twofold: first, a command of, and thorough understanding of, the meaning of language, and secondly, an appreciation of what is meant by accuracy and measurement. The subjects of English, Latin, and mathematics appear to be more suitable instruments for these purposes than the principles of biology and chemistry.

On this foundation should be built, in order to train the mind in the ideas of combination and dissociation of elements, correlation of organised structure, and life itself, the subjects of the first year, with frequent exercises in description of things observed and experiments involving weighing and measuring. The student should be by this equipped for the study of anatomy, physiology, and materia medica. But at present he unfortunately arrives at that stage accustomed to the conception that 30 per cent. of knowledge is a satisfactory standard, and that 50 per cent. confers distinction.

This suggests a digression in order to appreciate the value of the class examination as an instrument for teaching, and I hold that this essential appliance is badly misused. The element of competition is quite unnecessarily introduced, adding to the labour of the teacher without corresponding advantage to the student, and the test has become much more a test of power of memory than a test of power of understanding. The numbers of these tests are too few; each should be limited to a single problem; during them the student should be allowed access to his books and notes; and the teacher should discuss with those individuals who obviously require it those answers which are imperfect.

It would, indeed, be preferable to call them class exercises, in order to counteract the pernicious idea that every question is a skilfully constructed trap for the unwary. An exercise designed for testing information which has been committed to memory, such as, for example, dosage, should demand a standard of 100 per cent., and should be considered a bad test if the majority of candidates do not attain to a 75 per cent. standard. If it is said that this ideal is one which is impossible of attainment, the answer must be made that one of the requirements for successful teaching is the preliminary assortment of students into groups of approximately equal capacity. This has not been attempted, and is one of the reasons why the method of imparting instruction by means of the systematic lecture alone, or mainly, has so long persisted.

As materia medica consists of the knowledge of the properties of medicinal substances—physical, chemical, pharmacological, and therapeutic—and the methods of their employment (prescription-writing), there is evident convenience in studying the subject in the above order. But as the prescription is the obvious end and aim of the study, there is the advantage to be gained when prescription-writing is studied at an early period of the curriculum, of fixing the student's attention on the purport of his studies.

There seems to be no reason, then, why pharmacognosy, pharmacy, and elementary prescription-writing should not be studied along with anatomy and physiology, always providing that the less capable student, who cannot spare any time from the study of the two greater subjects, should not be allowed (after consultation between the various teachers) to embark on this additional study, and that he is under the supervision of the anatomist and physiologist for the whole of his time.

The study of prescribing and prescription-writing is of too great importance to be inadequately taught; and the comparative neglect of it in the past has acted to the detriment of the medical and pharmaceutical professions, and of the general public.

Pharmacology alone, without pharmacognosy on the one hand and therapeutic applications on the other, should not unduly add to the labours of the third year; and some of those facts which can be demonstrated experimentally should be shown to those who could appreciate them. It is worthy of consideration, moreover, whether it would not be to the advantage of the more capable student to arrange for him to perform certain pharmacological experiments in order to educate him further along the lines of observation, recording with accuracy and drawing legitimate inferences.

Therapeutics should then be studied after a knowledge of diseased conditions has been acquired, and studied systematically by the bedside, and during this period there should be further exercises in prescribing along more advanced lines, where, again, the teachers who had laid the foundation should come in contact with the results of

the teaching, to the great advantage of both teacher and taught. The power of prescribing would thus be more thoroughly tested than can be the case where a candidate for the final examination prescribes only for one or two clinical cases which are allotted to him.

There is no doubt that these requirements necessitate a largely increased staff, and there is nothing to be gained by concealing these necessities, and thus perpetuating a thoroughly unsatisfactory state of education. Were these requirements met, there could be established a pharmacological school which might be trusted to add to the reputation of our university.

XIX.—THE TEACHING OF MATERIA MEDICA.

By Professor RALPH STOCKMAN, University of Glasgow.

At a remote period in the history of cultured peoples a knowledge of materia medica constituted almost the whole sum of their practice and science of medicine. At the present time the term, in our Scottish schools of medicine at least, has come to be merely a conventional and brief name to denote a number of closely allied and interdependent branches of medicine. It is this which has introduced so many difficulties into the teaching. The teacher has to deal with pharmacognosy, pharmacy, prescribing, pharmacology, and therapeutics, and the last involves a certain amount of pathology and clinical medicine, not always of an elementary kind. One cannot teach therapeutics without trenching on these, and it is to be borne in mind that the subject includes not only the remedial action of drugs, but such measures as vaccine and serum therapy, massage, electricity, diet, climate, spas, and mechanotherapy. The different parts of the subject demand very different degrees of medical training and maturity on the part of the student. For instance, pharmacognosy, pharmacy, and prescription-writing are requisite at an early period of the curriculum; they can easily be learned then, and require very little previous knowledge for their study. A certain limited acquaintance with these subjects is absolutely necessary for the student and practitioner of medicine, but it could quite well be imparted in a short special course by a teacher who has been trained as a chemist and druggist. The most important point, in my opinion, is to settle whether the teacher is to be a pharmacologist with no pretensions to clinical knowledge and practice, or whether he is to be a physician who has had a special training in pharmacology and therapeutics. After a pretty long experience in teaching medical students I have no hesitation about deciding in favour of the latter. A pharmacologist working in a laboratory as his sole professional occupation soon loses touch with practical therapeutics. What he has to teach is of little interest and

importance to medical students or practitioners. Many such pharmacologists have been distinguished physiologists and physiological chemists, but their contributions to therapeutics or practical medicine have been singularly few and unimportant. Their work has mostly been explanatory of the known actions of old and tried remedies, or has systematised and extended our outlook on groups of remedies. Ehrlich may, I know, be cited as a striking example to the contrary, but the chemical part of Ehrlich's researches on organic arsenic compounds was carried out by a combination of chemists of great experience and ability. It is unlikely that it would be possible to obtain a teacher of pharmacology with sufficient chemical knowledge and skill to repeat or carry on similar researches. Speaking broadly, it seems to me that therapeutics can only be profitably studied on persons who are ill, and hence the teacher should have as wide an experience of this kind as possible. The teaching of a man who is merely a laboratory pharmacologist will lack conviction and real knowledge. The value of such drugs as iron, arsenic, mercury, quinine, salicylic acid, potassium iodide, emetin, and many others, can only be established in diseased conditions. Their action on healthy men or animals gives no clue whatever to their action in the diseases for which they are all valuable remedies. It is notorious that the laboratory studies of the action of digitalis have misled us as to its true action and its application in treating heart affections. A physician who knows the daily requirements of patients and practitioners, and who is well acquainted by experience with the shortcomings and value of remedies in their actual use, seems to me the only possible teacher of therapeutics.

The next point is to determine what the student, as a future practitioner, requires from his teacher. This, I think, can be answered very shortly. It is not merely an account of the physiological action of substances used as remedies which is required, but a carefully considered and well-balanced estimate of their value and application in diseased conditions. Pharmacological experiments on animals may or may not throw light on this. In any case they form a subordinate part of the subject, which is essentially a practical one.

I cannot say I am in favour of dividing up the subject and multiplying the number of teachers. Such a procedure leads to too great detail in teaching, and in a five years' course a medical student can only be expected to acquire a very elementary knowledge of any one subject in the curriculum. I do not think there should be a separate course of pharmacology and a separate course of therapeutics. The remedy for the present unsatisfactory position of the teaching of therapeutics would be for the student to start clinical medicine and attendance at lectures on medicine somewhat earlier than at present. He would then be in a better position to understand the meaning

and bearing of therapeutical measures. Real practical bedside training in therapeutics is very difficult to carry out. For one thing, and it is a very important point, the clinical material would be usually lacking at the time it was wanted. A little can be done in this way, but it requires years to accumulate gradually the mass of diagrams, tables, photographs, and results generally which are required for teaching therapeutics in a systematic manner, and these could hardly be demonstrated and explained at the bedside.

DISCUSSION.

PROFESSOR GULLAND.—For a good many years I examined in materia medica, and I made it a rule never to ask anything about the subject that I did not think it necessary to carry about in my own head. I think the main point in materia medica—as in everything else in medicine—is to aim at the selection of the significant and to let the insignificant go.

DR. JOHN ORR.—Materia medica and a knowledge of drugs is really the stock-in-trade of the future medical practitioner, which he is going to use constantly in his everyday practice. The *Pharmacopœia* is overloaded, and a great number of substances might usefully be eliminated from that volume. It should be revised in a drastic fashion so that remedies which are likely to be employed are given prominence, and some substances which are never used eliminated altogether. Some of the doses given in the *Pharmacopœia* are stated in amounts which would defeat their object by being either far too strong or, if given in the maximal dose suggested, would be too weak for the treatment of certain diseased conditions.

The recognition of the names of the various drugs and their physical properties, their method of being handled by practitioners, and their prescription should be taken at quite an early period in the course, so that the student may be familiar at least with the names of the substances which are to be used in medicine, their dosage, and the way to handle them. The teaching of the action of drugs might come in the fourth year, after the student knows something about physiology, anatomy, and medicine. At present he is taught medicine in the third year and starts at the same time pharmacology and therapeutics. At the beginning he has no notion of the names of the diseases and still less of the ways in which they manifest themselves, and therefore it is incumbent at present on the teacher of materia medica and therapeutics to discuss with him in many cases the salient features of a given disease, so that he may grasp the therapeutic effect. If the teachers of medicine in the third year could shortly allude to various remedies which are used in disease, the student could follow his pharmacological course much better, because he would already be familiar with the names of the drugs. When he comes to his fourth year he already has some knowledge of clinical medicine, of pathology, and of symptomatology, and if he began at this stage to study pharmacology and therapeutics he would get from his teacher much greater enlightenment as to the handling of the various drugs. The study of pharmacology is essential so that a student may understand the action of a drug in health and be in a position to understand how it will work in disease. If more time were available for the teaching of pharmacology, and especially

of therapeutics, it would be much easier for the student to derive benefit from his lectures than at present. I should widen the scope of the teaching of therapeutics to include not only the use of drugs, but also the treatment of disease by physical methods, electricity, etc., not forgetting dietetics. The best use can be made of the time the student has for pharmacology and therapeutics by dividing the subject, taking therapeutics, in the very broadest sense, at a later stage, say, in the fourth year. I also agree that the best teacher, making allowance for the needs of the student, would be a man actually engaged in practice—hospital, private, or both.

Dr. Chalmers Watson.—From the clinician's point of view, the first question we have to consider is, "What proportion of the benefit obtained from treatment by medical practitioners is due to the use of drugs employed by them?" I believe that drugs play a comparatively minor *rôle* in treatment. With the exception of a few really valuable drugs, like opium, castor oil, quinine, etc., with known definite pharmacological actions and proved usefulness because of that action, a large part of the benefit obtained from drugs is obtained solely through mental suggestion. The most important therapeutic agents in medical treatment may be shortly summarised as follows:—(1) Drugs administered for the cure of the disease, or for the relief of symptoms. (2) Diet. (3) Treatment by physical methods, including massage and remedial exercises. (4) Treatment by vaccines. (5) Last, but not least, the mental factor in therapeutics—psycho-therapy. The instruction given at present in all of these subjects is seriously inadequate, and great reforms are essential.

I should like a considerable curtailment of the time at present devoted to pharmacology and theoretical therapeutics, and the time thus spared devoted to the teaching of dietetics, the treatment of disease by physical methods on modern lines and with efficient equipment, instruction in the principles and practice of vaccine therapy, and the use of psycho-therapeutic methods, the teaching throughout being made as direct and practical as possible. We must get back to the fundamental point, that it is not so much a change of system as the adoption of a wider outlook by the individual teacher and the cultivation of a spirit of investigation on the part of the clinician that is required.

Dr. J. S. Fraser asked if there is any great point in teaching students how to make pills, suppositories, and plasters. He also entered a plea for more detailed teaching of methods of treatment at the bedside in hospital.

Captain Frank Fraser, R.A.M.C.—As I have but recently begun to teach, the difficulties a beginner feels are fresh in my mind. For example, one teaches the students with some degree of confidence a disease process, and what stage of that disease the patient before them is in. Then one tries to teach them the treatment—equally logically: one is beaten at once. We have never been taught what drugs or other methods of treatment are to be used in any particular stage of a disease. We should be able to class treatment under various heads. We should be able to say that this or that method will check or cure the disease, that this other will only enable the man to get through the world and to carry on his work more or less satisfactorily. When the student asks you, "How do you *know* this or that?" the only reply usually

possible is, that our treatment depends upon the experience of our forefathers, and is founded on impressions. Only in a very few cases can we give the student definite reasons and facts for using a particular treatment at a particular time. Professor Stockman mentioned this in speaking about digitalis. Even when I was a student digitalis therapy rested on pharmacology, or upon the clinical experience that in certain types of heart disease which were not well understood digitalis operated beneficially. It was left to Sir James Mackenzie to analyse the different types of heart disease and to show when digitalis will be of use and when it will not be of use. Even in the short time that I have been in hospital practice there are few methods of treatment in which our knowledge has made such strides as in digitalis therapy. If we are going to teach our students as widely as we can what disease is and how to recognise it in its different stages, we must also in its treatment know what to do and why to do it. For that reason the bedside is so essential. If you try to found your treatment on pharmacology you are lost ; if on your forefathers' knowledge, you feel you have not really got enough to go upon. Whether Professor Stockman meant as much as he said I do not know, but I was very glad to hear him put pharmacology, materia medica, and pharmacognosy rather to one side. In these subjects we should aim at giving the student the main features of what he will have to practise, and devote as much time as possible to therapy at the bedside ; and we must more and more try to teach him *what* and *when* to do.

Dr. Ker.—Professor Stockman tells us that the student is being taught too much. That is the conclusion some of us have come to already who have followed this discussion from the beginning. We are trying to put too much into the student ; his power of assimilation is, after all, distinctly limited, and guiding his reading rather than making him learn so much by heart would be much more valuable to him. Certain parts of every subject, of course, have to be studied very completely, and obviously the duty of the teacher is to settle for himself what those parts of his subject are. It would be a good thing if some method could be devised whereby a student, although taken over a great part of the ground he covers already, would not be examined on the whole of it, but would rather be taught how to look up information than to trust entirely to his memory. Under this system, of course, a very high standard would be adopted as regards things that he *must* know, things useful in emergencies that he might be confronted with at a moment's notice. By being asked to assimilate a large amount of useless knowledge the student is apt to forget the essentials and to remember much less necessary things. I would like some of these scientific gentlemen in laboratories to try and find out pyschologically how much the student can take in.

Dr. Traquair.—I was interested in Dr. Sillar's reference to examinations. The idea of allowing students to go to text-books and references is an excellent one. The examination should be quite as much a test of how to find out information as of how much the student remembers of what he has learned by heart.

Professor Lorrain Smith.—There is fair unanimity in what has been said to-night as to the necessity for readjusting the present form of teaching, and the only point I would like developed by the speakers when they reply is that they might give the club as far as possible their ideas on *how* the present method of teaching should be readjusted. It is clear that all the teachers

in materia medica and therapeutics desire to see the therapeutic side of their teaching carried on at a later period than the study of pharmacology. How is that to be readjusted to the present methods of teaching clinical medicine?

Professor Marshall said in reply.—*The* one point about which I feel strongly is that, as far as the ordinary medical student is concerned, the teaching, whether of materia medica considered as a whole, whether of pharmacognosy, pharmacy, prescription-writing or pharmacology considered individually, should be utilitarian. He requires an impressionistic picture of the pharmacological action of the different drugs, on which he may base their therapeutical applications.

I want to state very definitely, however, that the establishment of a pharmacological school in most of our great universities is also essential, and I would introduce into the science curriculum pharmacology as a subject, where it could be taught in its relationship to biology, chemistry, physics, etc.

Professor Stockman's remarks have been very much to the point, and I agree entirely with him. Most of our practical knowledge of the actions and uses of drugs has been acquired from investigation on man, largely from the trial and error experiment. Even Ehrlich's investigation of the organic arsenical compounds seems to have been suggested by the beneficial effect of atoxyl in disease.

Mention has been made of the *Pharmacopœia.* To a teacher of pharmacology and therapeutics the *Pharmacopœia* is a bugbear. It is not intended, of course, as a text-book for students. It is intended to supply the medical practitioner with the drugs he wants. The Medical Council does not undertake to teach the medical student or the medical practitioner what drugs he shall use. Consequently the *Pharmacopœia* merely defines what the desired drugs are, and as far as possible ensures that they shall be of standard quality. In theory at least it might consist of useless remedies, and in fact it contains much of questionable value. It consequently tends to establish a vicious cycle.

With regard to prescribing. One of the speakers asked what was the use of teaching students how to make pills and suppositories and so on. It is done to teach them, in the only efficient way, the forms in which drugs may be administered, and this is one of the necessary things in therapeutics. The student, when he becomes a practitioner, should be able to prescribe any drug he chooses in the most effective form and thus use it to the best advantage.

As regards the time that should be spent over materia medica, the essentials to be taught depend so much upon the individual teacher that it is very difficult to lay down any hard-and-fast rules. Personally, I would prefer to have a short course of pharmacy and pharmacognosy in, say, the second summer, followed by a systematic course of pharmacology and therapeutics in the third year. I think too much pharmacognosy is taught in some schools. It is not necessary for the practice of medicine to know the botanical origin and differentiating characters of, say, the two forms of senna leaves. As far as pharmacology and therapeutics are concerned, I am of opinion that the hundred-lecture system should be reconsidered. For the ordinary medical student seventy-five lectures would, I think, be ample, and they should not be given on consecutive days. One essential thing in the earlier as well as in the later years is to tell the student *how to use* drugs. I could relate instances of the inefficiency of treatment due, not to the choice of the remedy,

but to the improper use of it. I should like to see the clinicians alluding more and more to the proper application of remedies in the treatment of disease. I am not in favour of a prolonged course of experimental pharmacology such as is carried out in some of the universities of the United States, at least for the ordinary medical student. The results obtained are not, in my opinion, commensurate with the time expended.

I think, in the majority of cases, therapeutics is not sufficiently taught in the later years of the curriculum. The physician does not base his therapeutic observations to a sufficient extent on the knowledge which has been acquired by the student. He rarely explains *why* such and such a drug or such and such a combination is valuable. In all cases of bedside teaching he should state the prescription he is going to use and his reasons for doing so. The non-medicinal methods are, I think, also better taught in the later years. Before the war I used to have demonstrations of massage, and demonstrations on the use of X-ray and electrical treatment are still given. These things should be demonstrated, talked about, and illustrated as much as possible.

With regard to the professorship of therapeutics referred to by Sir Thomas Fraser, I do not think it is necessary to say much. Professor Stockman has made some very pertinent remarks on what can actually be done in teaching therapeutics practically, and I agree with most of what he has said. I am sure the institution of this Chair will be of benefit, but too much should not be expected from it.

Dr. Sillar said in reply.—Though it has not been said in so many words, I think all the speakers to-night have in essence agreed with every word I said in my paper. Firstly, nobody has attempted to defend our methods of teaching. I expected to find my statement on this point greeted with indignation, but it was greeted instead with what I take to be the silence of agreement.

Secondly, with regard to teaching by an expert. By an expert in teaching pharmacology would, of course, be meant a pharmacologist. Professor Stockman's view was, I think, unduly pessimistic. Very curiously, one suggestion he made as regards the teaching of one part of the subject was to introduce the expert. Why should he think it would be better to teach the medical student the little dispensing he requires from the instruction by a druggist rather than by a practitioner? They look at the matter of prescriptions from diametrically opposed points of view. I strongly object to the idea that the medical student's dispensing would be better taught by a druggist than by a man who understands the problems from the point of view of the practice of medicine.

It has been said that the teaching of the pharmacological action of drugs is practically useless. A great many of the speakers have left entirely out of consideration the fact that pharmacology is a subject in its infancy. Clinical teaching has been in existence for hundreds or thousands of years, and the accurate knowledge of the action of drugs gained in all that time obtained from clinical observation has not been great. It is too soon to judge as to what is going to be the future treatment of disease by medicinal substances. In the comparatively short time—about fifty years—that the pharmacologist has really been at work he has removed about half the substances that were previously being used in the treatment of disease. That is no inconsiderable

piece of work to begin with. More and more will the pharmacologist teach clinicians what substances he need not expect to find of any practical use. Within quite recent years we have had practitioners strongly upholding the value of sulphate of lead—an insoluble, unabsorbed substance—as an external application in the treatment of disease. Sarsaparilla not long ago was used as a routine treatment in syphilitic conditions. The pharmacologist has shown that these things are practically useless. Another point may be emphasised in connection with the labours of the pharmacologist, that although the treatment of malaria by quinine was introduced clinically or therapeutically originally, yet the practitioner now has as a scientific instrument in the treatment of malaria a more efficient weapon in his knowledge of the toxic actions of quinine on the parasite. It has always interested me as showing the power of a great mind that Binz, in the days when malaria was looked upon as a nervous disease, from his pharmacological investigations on the action of quinine on protozoa, said, "It will be found in time that malaria is a disease caused by a parasite." In many directions will the accurate observations of the pharmacologist bear fruit in the future.

With regard to Professor Stockman's question as to how many of us have ever given an emetic, I remember one instance when one of my students swallowed one and a half seeds containing croton oil. I administered a draught of warm water and mustard, and demonstrated the action thus practically to him. I do not see why such things should not be taught to the class by illustration on one of the students. In considering the action of purgatives, we want to know when we administer a purgative whether it will cause pain or griping, and within what time it will act. Is there any reason why we should not administer to half a dozen of our class and ask them to report upon the nature and time of the action?

Professor Marshall has put the matter of the *Pharmacopœia* succinctly. It is not a text-book. The question of doses is one for the experience of the individual practitioner.

The reason why we ask the men to make pills or suppositories or ointments is because it is the quickest and least wearisome method of impressing upon them the essential characters of these particular preparations, and to avoid the alternative of having to talk to them at length on these matters. It is the most practical method of teaching them what it is essential they should know.

With regard to pharmacognosy. Our teaching of the *Pharmacopœia* nowadays is cut down to a number of substances sufficient to develop the power of observation in the student. One would prefer, of course, to teach him generally how to observe by showing him half a dozen cases of different degrees of, say, cyanosis at the same time. He would examine other patients side by side, and observe the different odours in their breath. But to get such a selection of patients whenever they are wanted is, of course, impossible. And yet it is to be desired that the student will be trained to detect the odour of acetone in the breath, the colour of the lips, and so on, by a cursory glance. The whole educational object of studying pharmacognosy is to learn to observe minutely and to describe accurately. If we wish to teach the student the value of absorptive bases to be absorbed through the skin, he must have a practical acquaintance with the different materials—paraffins and fats. I was extremely gratified to see Sir Thomas Fraser's remark on prescription-writing,

because, though I myself feel that prescription-writing at present leaves much to be desired, I do think it is very much better than it was before we co-ordinated our teaching to this end. It is only the experience gained in teaching that gives one that sense of proportion which enables one to instil into the mind of the student the necessity of his laying stress upon what is important and of discarding what is not important.

Professor Stockman said in reply.—I think the defects would be largely removed from the teaching of pharmacology and therapeutics by making the student study medicine synchronously with them. A little knowledge of medicine would enable him to pick up many points in therapeutics which he would otherwise probably miss. The trouble lies in therapeutics being taken too early in the course. When a student knows nothing about medicine and the practice of medicine, it is very difficult to teach him anything about therapeutics. The men know neither pathology nor clinical medicine when they come to me, so that it is a very difficult matter to teach them therapeutics. I do not agree with Dr. Sillar that the subject is badly taught in medical schools. I think it is very well taught on the whole, in spite of the extreme difficulties, confirmed by Dr. Marshall. It is undoubtedly a subject that *cannot* be demonstrated systematically for teaching purposes on patients. I have tried, every teacher has tried, but from natural causes it is impossible, except in a very occasional and small way.

What I said about pharmacology referred only to pharmacology for the medical student, and not to the higher study of the subject, for I understood the scope of the discussion to have relation only to the teaching of the medical student. To have "a school of pharmacology" in the university would need a large staff and a much more elaborate organisation than at present, but the medical student can be far better taught all he requires by one man than by five.

We must remember that about two-thirds of the enormous amount of knowledge that a medical man has to carry about with him is weariness to the spirit. Although each department of medicine may in itself be extremely interesting, the details of all are intolerably wearisome, and must remain so. They do not stimulate the mind, they are merely efforts of memory, and that is why so many doctors are uninteresting in conversation and outlook—the stifling effects of the details of the curriculum have dulled them. It is certainly very desirable that teachers as a body should give their most earnest consideration to reducing mere details of instruction to a minimum. I am aware they cannot be wholly eliminated, but it should be borne in mind that the student is not being educated as a specialist in any one department of medicine.

The relative usefulness of drugs and other agencies does not, I think, come into this discussion. Personally, I teach physical therapeutics, and I do not think a special teacher is urgently required for medical students in this branch, except in electricity.

XX.—MEMORANDUM ON THE TEACHING OF "PUBLIC HEALTH" (?) IN THE CURRICULUM OF MEDICAL STUDENTS.

By JOHN ROBERTSON, Medical Officer of Health, Birmingham.

THE vast majority of medical students pass on to general practice or to specialised practice as surgeons, physicians, etc., and seldom have to deal with the specialised functions which have now come to be recognised as those of the medical man who deals with Public Health.

I would, therefore, like to abolish the title of "Public Health" as the name to be given to any course intended for the ordinary medical student. In its place I would substitute a course which might be called "Preventive Medicine," and which, while dealing with some of the ground covered in the present Public Health course, would deal more specifically with the prevention of disease as met with in the ordinary practice of a medical man and as needed in the interests of the community at the present time. I would, however, retain the title and scope of the present Public Health course for those who intend to qualify in Public Health as a profession.

In my ordinary work as a medical officer of health, and since the war commenced as a member of the Army Sanitary Committee, I have been brought a great deal into contact with medical colleagues who have been engaged in general practice, and who have been transferred to positions requiring knowledge of what I call Public Health problems. I have been surprised at the few of these who have been able to deal with such questions as water supplies, sewage disposal, soils, sanitary fittings, etc., etc. They have gone through the ordinary Public Health course, but obviously it is entirely inadequate to enable anybody to express an opinion on a water supply, or a sewage works, etc.

On the other hand, there is no group of men who have the opportunities of the general medical practitioner for dealing with individuals who require advice on the methods of prevention of the spread of disease. In my opinion there is a vast field of work at present almost untouched in the domain of the prevention of disease. Largely this is a personal matter, requiring the personal instruction which can be better given by the private medical attendant than by anybody else, and I feel very strongly that the duty should be cast upon the private medical attendant to a much larger degree than at present of dealing with prevention as well as the cure of disease.

We are at present too apt to think of prevention as applicable only to the so-called infective diseases. As a matter of fact there are very few diseases in regard to which preventive measures cannot effectively be taken. It may be said that all these problems are dealt with in the other courses which a medical student has to attend. As a general

rule, I would say that this is not the case, because there is so much to get in for examination purposes in the etiology, diagnosis, and cure of diseases that it is impossible for the teachers of these other subjects to deal effectively with prevention; and I feel that if a course were given on prevention it would draw the attention of the profession to its duty in this connection.

Few, for instance, of the medical schools have lectureships on tuberculosis. In a large number of the medical schools diagnosis and treatment are well done, but the teaching of methods of prevention of such a disease may or may not be.

A very large scope for prevention at present exists in regard to antenatal and early infant mortality, and so on—one might go through nearly the whole number of diseases dealt with in the ordinary medical course from their preventive point of view.

I believe there is enough to be done in a course of preventive medicine without trenching on the functions of the Professor of Medicine, or the Professor of Bacteriology, or anybody else. Many of the conditions causing illness and death are not dealt with in the present courses. For instance, the diseases which bring on premature old age are very important, and, similarly, those of dietetic origin.

If I am not mistaken, the National Insurance Act will demand that the panel doctor in future shall, as a part of his functions, advise as to means of prevention. The Act of Parliament is entitled "An Act to provide for Insurance against Loss of Health and for the Prevention and Cure of Sickness," and it is only a matter of time before these requirements will be put in operation.

It cannot be too often impressed upon the profession that the prevention of disease is much more important than the cure of it, and this idea ought to be impressed on the medical student.

XXI.—THE TEACHING OF PUBLIC HEALTH.

By Professor MATTHEW HAY, University of Aberdeen.

As a special post-graduate curriculum of training in Public Health is now almost everywhere provided for students aiming at an appointment in the Public Health Service, the course in Hygiene or Public Health for students proceeding to the ordinary medical degrees should be confined to the requirements of the ordinary medical practitioner, who is expected nowadays, more than ever, to have an intelligent understanding of the principles of preventive medicine and to be able to co-operate effectively with the health authorities in all measures for the prevention of disease. The practitioner is still too largely regarded by his patients, and, I am afraid, also not infrequently by himself, as being concerned only with the treatment of disease. As an advocate

of a system of Public or State Medical Service, I believe that we are not likely to attain a proper combination of the two functions in the practitioner until such a system is established; nor, I think, until then are we likely to secure quickly that scientific study of early symptoms which my friend and old fellow-student, Sir James Mackenzie, so cogently advocates.

The requirements of the practitioner in respect of hygienic instruction must include primarily full attention to all matters relating to personal and domestic hygiene, and, perhaps, to a lesser extent, to industrial hygiene, which is largely in the hands of specialists, although it is not without considerable practical value to the ordinary practitioner. Much of the elaboration that is necessary for health officers in regard to such subjects as water-supply, drainage, and sewerage can safely be omitted, especially on the engineering side, and to a considerable extent also on the chemical side.

The important subject of food and feeding is a part of the question of personal hygiene. Here, as in several other subjects usually embraced in a course in Public Health, it is very desirable that, in order to avoid overlapping, or, what is worse, to prevent lacunæ in instruction, by one lecturer trusting to another lecturer to overtake certain parts of a subject, there should be some considered arrangement between lecturers as to what parts each is to teach. Thus in regard to food much of the field may or may not have been covered by the physiologist, or possibly by the therapeutist or clinician. I am afraid many of us would have to plead guilty to failure in adequate consultation with our fellow lecturers. I suppose that Boards of Studies which came into Scottish university legislation for the first time in the ordinances under the Act of 1889 were intended, in part, to assist in such a matter, but I doubt if in almost any of the universities—I am thinking especially of the Medical Faculty—much effective use is made of these Boards in securing a periodical survey of the ground covered. At the present time, when much is being said regarding infant feeding, I have heard more than one practitioner from different medical schools say that they had had practically no instruction in it. The physiologist, the obstetrician, and the hygienist have each some responsibility. With this and some other not unimportant matters of medical instruction it is an almost literal dropping of them between two or three stools, or shall we say chairs. The care of the teeth is another of the subjects of everyday importance, regarding which practitioners sometimes make similar remarks.

A necessarily important and emphasised subject in every course of hygiene for medical students is the etiology of infectious diseases, their methods of transmission, and the means for their prevention. Here, again, there is obviously opportunity for overlapping between the hygienist and the lecturer in medicine. The field of the lecturer in medicine is so enormous, and his opportunity of seeing cases of the

more common infectious diseases has in recent years become so diminished by the removal of nearly all such cases to the isolation hospitals of local authorities, that the question is raised whether these diseases, or an agreed-upon portion of them, should not be more definitely detached from the ordinary course in medicine, and form a separate lecture course, with a fuller treatment of them than is possible in the existing short course at the fever hospitals. This is now the more necessary, as, except for the surgical cases, cases of tuberculosis are now almost altogether excluded from the general infirmaries. But such detachment would still require that consideration should be given to what should be taught in the hygienic course and what in the special course.

Among other subjects requiring attention in a Public Health course is vital statistics, in which some knowledge of the leading facts, as also an intelligent conception of statistical values, is desirable for the medical practitioner. Four or five lectures may sufficiently cover the ground. It is necessary also that practitioners should know something of sanitary law in relation not only to themselves or their patients, but also to broad questions of health policy. It would be a distinct advantage to the general welfare of the community if medical practitioners as a whole could have their interest more fully awakened in sociological problems of a hygienic kind. Medical practitioners have both opportunity and influence in directing and shaping public opinion.

So far as concerns the distribution of the course in Public Health in respect of lectures, laboratory work, and sanitary visitations, it would be easy to draw up an attractive syllabus of laboratory work; but if the course is not to extend beyond its present limit of about fifty lectures—which is, I think, sufficient, in view of the more special and elaborated instruction for expectant officers of health—very little laboratory work can be arranged for. The previous laboratory work of the student in the bacteriological and chemical laboratories of his medical school should have given him nearly all that could appropriately be taught to the intending practitioner. By the time the student reaches the Public Health class he should have already acquired a considerable amount of experience in the manipulative discipline which laboratory work affords, and of the things which laboratory work demonstrates. He has now reached the stage when the main value to him of further laboratory training is to enable him to carry through the particular examination or analysis with such precision as to give himself and others confidence in the results. Unfortunately, a great deal of laboratory work falls short of this, partly because the object sometimes of the teacher is primarily demonstrative, and partly because the time is inadequate to allow of the complete attention to details, and of the repetitions that are required to ensure some degree of mastery of the methods. When definite and important action may

have to follow on the result, accuracy and reliability are necessary. If, for example, the discharge of a typhoid patient from isolation is to depend on the proved and continued absence of the bacillus from the excreta, or if the selection or rejection of a water for potable purposes is to depend on the absence or presence of certain organisms, the practitioner, if he undertakes such examinations, must be certain of his results, or they may be worse than worthless. In regard to practical teaching generally, but especially in the later stages of the medical curriculum, I think that extensiveness could often with advantage be sacrificed for intensiveness. A degree of mastery within a limited range is, in my opinion, preferable to a wider range without any real mastery, and is a better basis for the work both of a common practitioner and of the aspiring scientific specialist. There are a few simple things that might be taught usefully in a laboratory to hygienic students, and which probably have not been taught in preceding practical courses, but whatever is taught in the laboratory should, as I have already said, be less for demonstrative purposes than for actual application and use in connection with medical practice, whether institutional or domiciliary, and be such as may on occasion be really required. In Aberdeen we have not at present any practical class for this purpose, although some twenty-five to thirty years ago, before the special teaching for health officers had been organised, we had a practical class for hygiene and forensic medicine, which was well attended, but at that time attendance on this class counted for the Diploma in Public Health. Forensic medicine and Public Health were then, and for many years subsequently, taught in one course. Now in Aberdeen, as in most other medical schools, they are most properly taught separately and by separate teachers.

Sanitary visitations, as an adjunct to Public Health lectures to medical students, are more easily arranged for than laboratory work, and may be distinctly instructive, such as visits to dairies, bakeries, and other works engaged in food preparation; to different types of housing; to examples of healthy and unhealthy industries; to schools and hospitals in regard to hygienic points in construction, ventilation, etc. Such visitations are included in the present course in Public Health in Aberdeen.

The only remaining point on which I am expected to express an opinion is the position of the Public Health class in the medical curriculum. Logically it ought, like the class of forensic medicine, to come at the very end. For their full exposition, both subjects have to build on nearly all the other subjects. But the last year of the medical curriculum is presumed to be wholly devoted to clinical teaching, and we all know that, even if this presumption were loyally acted upon, there would not be reasonable room for the ever-increasing multiplicity of clinical departments. So, as with several other subjects, a com-

promise in respect of what may be called ulteriority has to be accepted. It is curious that the struggle or manœuvring for position in the medical curriculum is mostly for ulteriority and not for priority. The study of Public Health ought to follow at least the study of pathology, and, of course, physiology, and we aim at this sequence in Aberdeen, as the prescribed curriculum shows. But we allow the examination in Public Health to be taken at the same time as the examination in pathology, if the student so desires, but it ought not to be so taken if pathology has been passed at the normal period, namely, at the end of the third year. Public Health is studied in the first term of the fourth year—the presumed last year for classes other than clinical classes. The senatus impose the condition that a student will not be allowed to pass in Public Health if he has not previously or simultaneously passed in the other subjects of the group, barring forensic medicine. It would be better if Public Health and forensic medicine were to be taken in the summer following the fourth winter, and a proportion of the students take forensic medicine in this summer and Public Health in the first term of the fifth winter, but I have already referred to the difficulty of the fifth winter. The fourth summer is also very full of clinical specialties, more particularly, it may be, in Aberdeen than in Edinburgh, as in Aberdeen a student who begins his curriculum in summer, as many do, can take his final examination at the close of his fifth winter. These difficulties lead to the question so often discussed, as to whether the subjects of the present first year of the medical curriculum, excepting anatomy, are to be relegated to a sort of preparatory curriculum, whether in or outside the university, or whether a sixth year is to be added to the curriculum.

XXII.—THE PLACE OF PUBLIC HEALTH IN THE MEDICAL CURRICULUM.

By Professor HUNTER STEWART, University of Edinburgh.

In discussing this subject, help may be got in recalling the work done by medical practitioners on the etiology of disease and the methods of prevention. Without going into detail on a matter well known to all conversant with the subject, some outstanding examples suggest themselves. The discovery of the great preventive measure in smallpox—vaccination—was made by Jenner in the course of his work as a medical practitioner, based on observations made in the ordinary routine of practice, and very shortly after that discovery a number of medical practitioners in Edinburgh were the first to provide free vaccination to the poor. The laborious work of another medical practitioner, Dr. Turner Thackrah of Leeds (1831), on the *Diseases of*

Occupation, their Causes and Prevention, was the first to focus attention on this subject as it affected this country, and of which Sir John Simon in his *English Sanitary Institutions* says, "Not under any official obligation nor with any subvention from Government, but as his own free gift to a public cause . . . he made it a matter of common knowledge and of State responsibility that in certain of our chief industries special influences, often of a removable kind, are apt to be associated, which, if permitted to remain, give painful diseases and premature disablement or death to the employed persons." Twenty years later, and as a result of observation of cases occurring in their practices, Dr. Snow and Dr. Budd were probably the first to show, at all events in this country, that drinking water polluted with bowel discharges from cases of cholera and of enteric fever was an important means of spread of these diseases, and they thus gave a great impulse to measures for the protection of drinking water from fæcal contamination, and to the adoption of efficient methods of removal and disposal of sewage. Pioneer work on the effects of overcrowding and of impurities in the air of occupied dwellings, as causing and spreading diseases, *e.g.* typhus fever, tuberculosis of the lungs, etc., might be referred to, but sufficient has been said to show the part taken in the past by the medical practitioner in preventive medicine.

Later, and largely as a result of this work, Government and Municipal Authorities took up the matter of administrative hygiene, and the need for special medical officers was recognised and their appointment required by the Public Health Acts, 1872 and 1875. In connection with this it is interesting to note that in 1874 Mr. Lyon Playfair (later Lord Playfair), a former Professor of Chemistry in the university, and then its representative in Parliament, and who had long taken a practical interest in hygienic questions, suggested to the university the importance of providing a special training and a qualification in Public Health for graduates in medicine who had such appointments in view. The degree of B.Sc. in Public Health was established in 1874, and was first conferred in 1875.

Though the great advance in Public Health administrative work of recent times, and much of the research in connection with the causes and means of prevention of disease, is due to the Public Health Service, central and local, the importance of the work by the medical practitioner remains. It will be readily admitted that in his practice he has an opportunity, possessed by no other, of observing the effect of conditions inimical to health, and of showing his patients how these conditions can be prevented. To him his patients must look for guidance and instruction in individual and private hygiene. Some of the recent advances in public hygiene, indeed, *e.g.* child welfare and maternity schemes, prevention of venereal disease, etc., are due, in the first instance, to pioneer work by men in private practice. The aim of

teaching the science of Public Health to students of medicine should be to fit him for carrying out this part of his work, and also to form an introduction to its more advanced study should he elect after graduation to take a special qualification in the subject.

The course in the medical curriculum in the University of Edinburgh is broadly as follows:—There are thirty-five to forty lectures, illustrated as far as possible by experiment, six lecture demonstrations, and four laboratory demonstrations. These latter are chiefly microscopical, and are personally superintended by the senior assistant in the department, and by another, sometimes by myself. I find it most important to have this personal superintendence to ensure that the student really sees and understands what he has seen, and what it is meant to teach. The first part of the course is taken up with elementary vital statistics, including estimation of population, birth-rates, death-rates at all ages and at different periods, but especially from 0 to 5 years of age; zymotic rates; certification of the cause of death. Then follows a study of the causes, the means of spread and methods of prevention of the notifiable diseases, etc.; duties of the medical practitioner as to notification of infectious diseases; case mortality of these diseases—how affected by sex, age, and environment of the patient; preventive vaccination, especially in smallpox; Vaccination Act; disinfection of rooms, clothing, and discharges from the sick. The statistics discussed are intended to teach accuracy in expressing the effect of these conditions, as well as of the preventive measures and of treatment. The meteorological factors of climate and how these are observed; the influence of pressure, moisture, temperature and winds, as illustrated by sea, land, mountain, and tropical climates; health precautions in mountain sanatoria. The dwelling—site and exposure; dampness of dwellings; cleanliness of and in the dwelling; sanitary arrangements; the source of impurities, gaseous and suspended, in the air of occupied rooms, and their effect on health; diseases caused or spread by overcrowding; cubic space and ventilation; personal hygiene—baths, suitability of clothing, etc. Duties of the medical practitioner under the National Insurance Act. School hygiene—sanitary requirements, cubic space, and ventilation; prevention of spread of infectious diseases in schools. Occupational mortality; dangerous trades; notification under the Factories Act of certain diseases; causes of these, and their prophylaxis. Water-supply, sources, filtration; diseases spread by water; characters of a good drinking water; interpretation of the analysis of drinking water. Foods; milk; composition of human and cows' milk; risks of contamination from cowhouse to consumer; bacteriological condition of milk as supplied to consumers; pathogenic organisms in milk; effect of Pasteurisation and boiling on these, on the non-pathogenic organisms, and on the constituents of milk; infant feeding. Child Welfare

schemes. Preserved foods and food poisoning. Sanitary disposal of the dead.

Some development of the teaching should, I think, be made. A short course of instruction on the Medical Inspection of School Children would be valuable. Further, though Edinburgh is not at present the centre of an industrial area, it will probably become so, and facilities be got for extended and more practical instruction on the causes and means of prevention of industrial diseases. As Public Health administrative work develops it is, I think, important that the instruction of students of medicine should develop along the same lines so as to enable the practitioner to take his legitimate part in protecting the health of his patients, and thus work hand in hand with the Public Health authorities.

DISCUSSION.

Dr. Leslie Mackenzie.—In the papers read to-night nearly all the points that want elucidation have been put before us, but perhaps I might indicate to you what in my own experience I have found to be the most striking gaps in the education of the medical student, not only as regards the Diploma of Public Health—a subject by itself—but also as regards what minimum of Public Health should be required of students of medicine proper. My experience of the general medical practitioner—fairly continuous for twenty-five years in both county and town work over Scotland—is that scarcely ever do you find a man who has got into the habit of looking at things from the administrative side ; the normal attitude of the medical man is primarily clinical. Not only that: his clinical insight is limited to cases of gross disease. In approaching the question of medical inspection of school children, for instance, nothing was more striking than the disgust of many men at having to bother themselves over such a trivial matter. They are not to blame, because their whole training taught them to pay little attention to the things that do not require an actual medical prescription and treatment. The medical inspection of school children has helped the practitioner to a greater insight into preventive medicine, as Dr. Robertson suggests it should be applied.

Another thing I have found very defective : when you ask any man who is not accustomed to write a report on a case—I speak now of poor-law work—you find his conception of putting it before you, with all its relevant details, is very elementary. That is a side of the whole of medicine which I have long thought has been distinctly neglected in the curriculum ; there is no class, except, perhaps, that of forensic medicine, in which a man is taught what is wanted even in a death certificate, much less in an official report. There is no administrative medicine taught at all, with the single exception, perhaps, of the formula for certifying lunatics and a few other things outside the immediate course of Public Health.

Both Professor Hay and Professor Hunter Stewart speak of lectures being necessary. For thirty years I have preached against lecturing ; I should say that nearly half of the curriculum, in all classes of medicine, is over-lectured. I have found in actual practice that one is far more successful by confining oneself to a much narrower field. My students get data and material of a

practical kind, and learn from that inductively. I have tried to follow the same idea in connection with the Hygiene Training Colleges. Instead of merely giving lectures, the doctors were required to produce so many children, and the men in the colleges examined them within the limits of the knowledge required by a school teacher. The result was a transformation in the ideas of the medical men and of the students. The actual amount learned was more limited but much more inductive. I think that the defect in the whole curriculum of Public Health teaching to the medical student is that he is given far too much. Professor Hunter Stewart, for instance, practically gives everything in his ordinary course for undergraduates that would be required by a man taking a Diploma in Public Health. If one tries to cover too wide a field the result is that the man gets up enough to pass an examination and be done with it, but when he comes to actual practice he has to revise for himself. If I had to teach a class of Public Health to medical students, I would think out just what it is that every general practitioner is necessarily thrown up against, and work backwards. As things stand just now, early atypical cases of infectious disease always come to them as a surprise. You *must*, therefore, have something perfectly exact, compact, and precise about all the primary infections ready to put into the student's mind, but instead of elaborating the whole of bacteriology, one should confine oneself in Public Health to the things that actually need to be done by the practitioner. He should be taught what he has to do in a case of scarlet fever or typhoid, and how to get into touch with the administrative machine that takes charge of such cases, and so on. Some men are taught far more about summer diarrhœa, typhoid, carrier cases, sewage, drainage, etc., than we have any right to ask a student to carry with him. The essentials of these things can be taught quite simply and practically partly by demonstration and, more important, partly by observation. In Aberdeen they have arranged as far as possible to work inductively. This develops great keenness of mind in the students and stimulates them to work backwards as it were, and their lecture passes into its proper place as a method of correlating their experience rather than as an attempt to convey experience.

In the matter of statistics, it is absolutely essential to know two or three fundamentals. But statistics are one of the great temptations of medical officers, and are mostly statistics about unrealities. I have got so tired of reading useless tables of figures that I have taken occasion to point out to some of my statistical friends that one gets as many facts from one case carefully managed as one does from hundreds of reports and tables. I learned this to my cost in the matter of the medical inspection of school children, where I gave currency to the weighing and measuring of them, and found that in a few years we were flooded with acres of tables, most of which were simply wastepaper. This sort of thing can be cut down, with tremendous saving of time, to two or three perfectly useful formulæ that ought to be in every general practitioner's mind. I agree with Professor Hay that the aim should be mastery within limits rather than the attempt to cover a wide area. Our ideas of preventive medicine are no longer what they were, and the science that began in clinical medicine and specialised out as methods of regulation, sanitation, and investigation of disease, has by a curious perversion of administrative development become so detached from clinical medicine that medical officers of health have often said to me that inspection of school children is

not Public Health. They think nothing is Public Health except drainage and sanitation! I should like to see preventive medicine taking the broad scope suggested by Dr. Robertson. I gather that he wants the students coming to the Professor of Public Health, after they have been disciplined in other subjects, to take up with him the points necessary to put them in touch with the proper attitude to infection, to hospitals, to nursing, to tuberculosis, to food, to infant welfare, to clothing of infants, and so on. We found, for example, in connection with the travelling exhibition on child welfare, that medical men all over the country welcomed it in the most naïve way as filling a gap in their knowledge, for some of them had never before seen such things as infants' clothing, sucking-bottles, etc. Preventive medicine should, in my opinion, embrace not only sanitation, sewage, and drainage, but the environment and personal welfare of the individual from the antenatal stage right up to adult life.

Dr. Guy.—In the teaching of Public Health it is essential that the teacher should keep clearly in his mind the ultimate goal of his students. If he misses this, he misses a point of prime importance. His teaching may be interesting to a degree, but it will tend to be divorced from the practical things of life. Very few of the students ultimately enter the Public Health Services, and for their instruction a distinct extensive post-graduate course is prescribed.

The great majority of students end as general practitioners and many of them as practitioners on the insurance panel. That is, they spend their days in the laborious routine of a busy working practice. Now, in my judgment, Public Health should be so taught that these future practitioners, who form the great bulk of the students, should get some idea of the relationship of their individual efforts to the general Public Health. They should also get the idea fairly implanted in their mind that their highest aim ought to be the *prevention* of disease.

I took the trouble this week to read through the notes of two very complete courses of lectures on Public Health: one delivered last year in this city, and the other also delivered here fifteen years ago. A few salient points impressed me. The notes of the lectures delivered fifteen years ago when compared with those of last year seemed wonderfully up to date. They both agreed in the manifold diversity of material which the teachers had laid under contribution. Anything that in the remotest way touched Public Health has been discussed —things in heaven above, in the earth beneath, and in the waters under the earth—anything, in short, from stratified clouds to artesian wells. A considerable time was apparently spent in showing the student how to calculate the dew point from the wet and dry bulb thermometers. Cyclones, anticyclones, isotherms and anemometers are doubtless interesting things for aeroplane pilots, but have no practical bearing in the life of the general practitioner.

The process of the estimation of the amount of albuminoid ammonia in water is of importance to the specialist, but is it the sort of Public Health to be taught to future general practitioners?

There appears also from my study of these notes to be a complete lack of proportion in the relative importance of the various subjects. For instance, the same time was given to smallpox as was given to tuberculosis. I have no wish to minimise the importance of smallpox, but whereas its death-rate is nil, tuberculosis kills 1000 per week. Again, I met such a sentence as this—

"Milk can convey such diseases as diphtheria, cholera, and also tuberculosis." Now, my criticism here is, that the relative importance of things has been altogether lost. Doubtless milk can convey the germ of cholera, but in these islands that fact is not for a moment to be classed with such an important subject as tuberculous milk.

Again, I missed many points which seemed to me to be of considerable importance. Syphilis and gonorrhœa have surely a Public Health aspect, and yet these diseases were never mentioned. Tuberculosis is a subject meriting a wide consideration, and yet far more attention was paid to meteorology. Housing was hardly even described as having any bearing on Public Health. Damp courses in walls were prominent, but the wide and great problems connected with housing were not spoken of.

Public Health admittedly has its problems in the factory life of to-day, and yet industrial hygiene was never introduced. Are there any Public Health problems in connection with excessive drinking? Surely; yet intemperance as a cause of disease was not touched upon. My conclusion when I had read through these fairly full lectures was that the teaching of Public Health wanted remodelling altogether. What I should call the new aspect of Public Health has been missed entirely.

It appears to me that the better way to teach Public Health would be to begin with the child. Place the child in the midst and say, "Wanted a healthy child." This would introduce at once the care of the pregnant mother, with all its wide ramifications, as the feeding of necessitous expectant mothers, the antenatal clinic for diseased mothers, the pregnant mother in the factory. It would also introduce the question of maternity homes, the proper amount and method of dispensing the maternity grant, and the question of a maternity service.

With the birth of the child there could be mentioned the Births Notification Act, with its later provisions, and the various parts of the Children's Acts which deal with medical matters.

The risks the child runs in his first few months and in his first year of life could next be touched on, and then infant mortality could be introduced, not as a matter of abstract tables, but as something having a definite bearing on the life of the child. At this point child-welfare centres, preventive and remedial, could be explained. The problem of illegitimacy would next arise, and should be treated, not as a percentage rate of the total birth-rate, but as a live question demanding attention, and that immediately, in view of the higher death-rate amongst these unfortunate babies. Next, the various institutions which deal with child life could be brought under the student's notice, and their function and purpose explained—the crèche, the day nursery, the toddler's play-ground, the play centre proper, the kindergarten, etc.

Next, the child might be considered as a unit in a family, and this would be made the text for the introduction of the hygiene of the home. The environment, situation, ventilation, and lighting could be dealt with, and all dealt with, not as an end in themselves, but in order that the particular child might be enabled to grow up healthily. Next, the school life phase of the child's life should be considered in all its completeness and the special problems arising there discussed, having always in view that the practical outcome should make for a healthy school child. The whole field of school inspection could be here surveyed.

In like manner the adult should be dealt with, and the various points of importance in commercial life introduced—water supplies, refuse destruction, sewage disposal, and a few of the more important laws and bye-laws relative thereto could be touched upon. Factory life, with its associated problems of hours of labour, fatigue and its causes, and industrial diseases could be dealt with.

All the while the prominent ideas should be the prevention of disease, the maintenance of the adult in good health, and the important position that the student, as the future practitioner, will be called to occupy in relation to these ideals.

In the end our hypothetical individual might be buried, and this would give occasion to discuss the death-rate, earth burial, or cremation, with the laws relative thereto.

Treated in this fashion it seems to me that Public Health would appear in a new light altogether to the student, and would be of greater practical use to him in his life as a practitioner.

Dr. Currie.—The point of view from which the matter has been considered this evening is one which does not naturally appeal to me so much as the attitude of the Medical Officer of Health himself. I think for the ordinary Medical Officer of Health a secure foundation on the bacteriological, chemical, and epidemiological side is very important. Looking back on my own work, those three subjects of bacteriology, analytical chemistry, and epidemiology strike me as being conducive to one's ease of spirit. As regards bacteriology, the Medical Officer of Health will either do it himself or hand it on to someone else to do. If he does it himself, it is obvious that he must know as much of the subject as possible. But even if he is not going to do it himself, he has to control the expert—a very difficult task requiring considerable acquaintance with the subject, as well as tact and understanding. Many important problems may turn on what appears to be a small bacteriological point, and if the medical officer has to take the expert's opinion without being able to criticise it he is not in nearly so secure a position as if he had had a practical experience of the work himself. That is why I should wish the foundation of a practical knowledge of these three subjects to hold an important place in the medical curriculum. They should, moreover, be taught at an early stage, because they are things which a man can never acquire by intuition afterwards. Administrative acumen in regard to the general problems we have been discussing to-night will come to a man as his views on life expand, and what he may at first be deficient in he will make up as the years go by, but this is not the case in the three subjects I have cited, nor in a knowledge of the specific fevers. That, of course, is not the only side of Public Health work, but it is a very important side. Such important questions in the course of a medical officer's career may turn on his acquaintance with the symptoms of the specific fevers that I do not think too much time on the clinical side can be given to them, either during the man's course as a medical student or afterwards when he comes to take out the special course which prepares him for the Diploma of Public Health.

Turning now to the student in general as opposed to the student who intends to take up Public Health, I add a few words on the preventive aspects of the Insurance Act in its relation to medical teaching. Dr. Robertson has reminded us that the Act as a whole has a preventive outlook. It is so

with medical benefit. It has been said that the Insurance practitioner spends his time in curing trivial ailments. On a broader view it might be held that he spends his time in forestalling serious ones. Such work is all in the way of prevention.

Sanatorium benefit, again, deals with the treatment of tuberculosis, and the Act itself provides funds for the erection of sanatoria. The medical student should understand clearly that the value of these facilities lies, not in treatment alone, but in the part which they should play, if rightly used, in checking the spread of the disease. He should realise the importance of early diagnosis, and should come to feel that it may depend on his own alertness whether his patient has a chance of recovery and his patient's family a chance of escaping infection. The instruction of the student along these lines would be preventive teaching.

Maternity benefit, which takes the form of a money payment, ought, if rightly used, to prevent in the mother the complications which may follow a premature return to work or household duty, and to promote the infant's well-being during its early days. The medical man, if present on the occasion, may have the opportunity of giving useful advice. These questions open the wider subject of child welfare, which should be represented in the medical course.

In the last place, I may refer to the preventive aspects of sickness benefit, which is a money payment during incapacity for work. These aspects, which are obvious enough, are apt to be complicated by the intrusion of the malingerer. The medical man can render a valuable public service here, both on the financial side and in the interests of national efficiency. Thus a week's rest for the worker at one time may prevent a long illness later : or a short extension of convalescence may make the difference between complete and partial recovery. The practitioner's duty in these matters is often difficult, and its exercise may sometimes expose him to blame. I think that the instruction of the medical student in some of the pitfalls of this work, and in its importance on the preventive side, might usefully find a place in the curriculum.

Dr. Norman Walker.—The first point in to-night's discussion that appealed to me was Dr. Robertson's suggestion that the medical student should not be taught along the lines of the Diploma in Public Health, that his course should be of preventive medicine, and that the Diploma in Public Health should be a great deal more practical than it is at present.

Professor Hay's remarks referred to the question of ulteriority and priority, a matter which comes in of course in all the subjects. Might not this competition be avoided by the expedient of conjoining the courses much more than is at present done? The present system of a series of short courses is not a good one for the student. He is supposed to cram in in eight or nine weeks all the instruction in a particular subject. In this subject it is a common experience to find the men well up at the examination, but twelve months later before qualifying they have forgotten everything they had learned. If Dr. Robertson's idea of a preventive medicine course be carried out, why should it not run far longer than ten weeks? Medicine begins in the third winter here. Why should not the teacher of preventive medicine come into the class as it goes on and teach the preventive aspect of things as

they come up? I would much sooner have the students once a week for eighteen months than every day for ten weeks.

The question of the Diploma in Public Health is, I think, out of our consideration to-night. I feel a considerable amount of sympathy with Dr. Guy when he says that meteorology is not a thing which very much concerns the average student. Twelve months after the class not one in a hundred would know anything about it.

I would rather take issue with Dr. Leslie Mackenzie in his wholesale condemnation of lectures. I have attended three series of discussions of this kind here—one of them a great many years ago, at which Sir John Struthers expressed himself as very much opposed to lectures and the late Professor Rutherford as in favour of them. While I have great faith in practical teaching, I should be very sorry to give up a considerable number of lectures. There is a theory that the student reads. But he does not read the right thing so far as my experience goes, and I think the curriculum would lose if we were to get rid of all lectures.

The point I am most anxious to make and should like to have seriously considered by the authorities in connection with teaching is the spreading of the special classes over longer periods than they occupy at present.

Dr. Rainy.—Dr. Leslie Mackenzie put it that practical work was essential. It seems to me, however, that in some aspects to do the practical work in Public Health would be much more difficult than in most classes. How would he propose to carry out slaughter-house visiting, sewage inspection, and so on, with classes as large as we have them now? Would he multiply the assistants?

Dr. Leslie Mackenzie.—I did not mean that we should get rid entirely of lectures in order to spend the time on the merely practical, but what I missed myself, and what I know the men miss, is a want of familiarity with the realities, when they have learned merely by words. There is so much concrete material that can be put before them to force them to exercise their faculties of observation. The splendid practical classes in physiology, anatomy, etc., have led to such a transformation in practical laboratory work that now, instead of being scoffed at, it is used as the basis of the theoretical instruction. The same thing applies to clinical medicine. You put stress on your cases in a way that is absolutely a part of medical teaching, to my mind. I would aim at the same sort of thing in Public Health. There is nothing so easy; the material is endless. I strongly share Dr. Guy's feeling that Professor Hunter Stewart's course teaches far too much, except for examination purposes. In view of the developments in the Army, one cannot forget that during the next four or five years the importance of the question of physical education and remedial massage and gymnastics—in fact the whole matter of physical methods as applied to health—will be vastly enhanced.

Professor Lorrain Smith.—I have a very strong feeling that a cardinal point in medicine should be a knowledge of nursing and the method of training nurses to carry out treatment. Where you have an intelligent mother or person in charge it is all right, but otherwise disasters happen. I do think that a great deal could be done in administrative medicine if the nurse were kept to the front as the person responsible for carrying out the medical instructions.

The general practitioner is brought face to face with an enormous number of practical little things which he has never thought of and never seen.

Dr. C. B. Ker.—As far as we have gone to-night we have more or less come to the conclusion that too much is attempted to be taught, and that it is taught too much for examination purposes. Dr. Robertson's point that the student should not be expected to learn what is really proper to the Diploma in Public Health is quite sound.

Professor Hay made a suggestion which I think would be unfortunate were it carried out, viz. that the infectious diseases should be separated from medicine. The student has already far too many classes to go to, and I do not think that there would be any particular advantage in cutting out this group of diseases from the syllabus of the professor of medicine. On the other hand, there are certain difficulties in making students familiar with infectious diseases, but we shall just have to continue to put up with these difficulties. It all depends on when a man comes to the fever hospital whether he sees particular diseases or not. What he wants to do is to learn to read intelligently.

It is a little dangerous that the Medical Officer of Health should be encouraged to regard himself as a bacteriologist. How can he do his own work and keep up with the developments of modern bacteriology?

In the old days when we were taught in a course of fifty lectures medical jurisprudence and public health together we knew just about as much as the medical student to-day, and we saved about fifty lectures. The idea of running the course of Public Health over a longer period is a good one. If it were run over the last three years of the course the men would take more interest in it: say one lecture a week or a fortnight. With a little co-ordination much advantage would accrue from this arrangement.

Professor Lorrain Smith.—We should probe a little further Dr. Robertson's position when he says there are very few diseases in regard to which preventive measures cannot be effectively taken. I understand the suggestion is that there should be a system of teaching the preventive side over practically the whole range of systematic teaching in medicine.

Dr. Robertson.—Of course that idea cannot be worked out very practically for many diseases at the present time. We are preparing the medical men for *national* work, and therefore it is important to the nation that they should have the idea of prevention instilled from the start of their teaching in medicine to the finish of their course. I cannot express too strongly my admiration for the general practitioner: he is the basis of all medicine. My great regret is that as a Medical Officer of Health one is out of contact with the sick individual. Diseases like bronchitis and pneumonia could be greatly affected by preventive medicine; if chairs of preventive medicine were established, duodenal ulcer, gastric ulcer, colitis, and many other diseases which cause serious illness could be tackled with advantage. It would pay the Government enormously to see to this, and I hope that soon they will attend to many of these questions of clinical research, and that the National Insurance Research Committee will presently deal with much wider subjects than they do now. The general practitioner needs to know everything that can be known at present in regard to preventive medicine.

PROFESSOR LORRAIN SMITH.—I gather that, so far as munition work is concerned, a start has been made in this direction by Sir George Newman, who is tabulating the particular ailments which come from overwork or from work causing special strain or special exhaustion. I suppose that is the sort of work on which you would base your idea, Dr. Robertson? But how would you carry it out? What type of person would be expected to undertake this teaching?

DR. ROBERTSON.—In the case of Public Health there is not much in a name: it is a name applied to a whole series of subjects grouped together that are more or less useful. I have said that I would abolish the subjects at present taught so far as the teaching of the medical student is concerned. But they could be very much more developed than they are at present for the benefit of the Diploma in Public Health student, who could follow them quite well if he had got a good primary scientific training, *i.e.* if he had been well taught in physics, chemistry, and biology. When you come to the teacher whose special duty this "Public Health" teaching is—I do not think he exists at the present time. Take, for example, the Professor of Public Health in *any* university just now. He runs over fevers in the way the text-books do; but I think he should consider their prevention very much more practically than is done at the present time. I would take nearly all the other diseases dealt with by the professor of medicine, and without doing too much on their treatment one might discuss their etiology a little more. The point is, if you give these things as a special course the student will be impressed with the absolute necessity for advising everywhere and everybody on the means of prevention. Every day I see all sorts of opportunities missed by medical men with the best of intentions. If they were imbued with this idea of prevention, when they came across a bad house or conditions they would take steps—or make their patient do so—to set in operation the authority needed to remedy the matter. In this way an enormous amount of disease could be avoided. The question of proper physical culture is emphasised by the conditions in the Army. This also might quite well be taught as a part of preventive medicine. In America it is considered such an important subject that several universities have appointed professors of physical culture, who are doing magnificent work in many directions.

PROFESSOR LORRAIN SMITH.—The best illustration I know of preventive medicine is child welfare work. It is essentially an instance of preventive medicine applied to the individual. I gather that you would extend this conception generally?

DR. ROBERTSON.—Yes, to the baby, the toddler, the school child, and the young adult; and I think very urgently also to the middle-aged man. Many middle-aged men could have their lives extended by five or ten years if they were told in time that certain things were obviously damaging them.

DR. CHALMERS WATSON.—As a clinician, I consider that the ideal course of preventive medicine for medical students would be framed on the lines laid down by Dr. Leslie Mackenzie and Dr. Guy. Such a course would involve a revolution in the present system of instruction. It would be of great advantage to the clinician to know that the subject of preventive medicine

was being presented to the student on such broad, practical, and modern lines. One could not but be impressed by the breadth of outlook revealed in Dr. Robertson's paper. He approached the subject largely from the standpoint of the physician, and I agree with him as to the value of preventive medicine, both in young adult life and middle age. The subject of diet is of fundamental importance, but little or no serious attention is paid to it in the curriculum. I should like also to associate myself with Dr. Mackenzie's reference to the value of the nursing profession, and to the possibility of attaining greater assistance from them.

Dr. Traquair.—I feel very strongly on what Dr. Walker said about spreading special classes over a longer time. In connection with diseases of the eye, I suppose there are about 30,000 blind people in the United Kingdom, half of whom owe their blindness to preventable causes. Including accidents and taking thought of the number of hours lost by workmen owing to small injuries of the eye, one realises that the loss of time and wages due to preventable affections of the eyes is enormous. If the general practitioner regarded prevention seriously, the public would in time do so also. At present, for example, it is an exceedingly difficult thing to persuade workmen to protect themselves against eye injuries.

Dr. Gibbs.—My own little speciality illustrates Dr. Robertson's views well. Dental caries and pyorrhœa alveolaris are the two commonest diseases of western civilised life, and the most easily prevented. I have been reading Dr. Leslie Mackenzie's last Report on Scotland, in which he points out that we do not probably know all the factors that lead to these conditions. That is quite true, but we do know by long clinical experience that by the very slightest attention to diet these diseases can be absolutely prevented. The child can grow up with no dental caries; the adult can keep his teeth to old age. I have been preaching this for the last fifteen years, but the ignorance of the general practitioner undoes practically everything that many of us keenly interested in preventive medicine in this direction are trying to do. I, for one, am constantly up against the medical man insisting on my patients having sweets because "sugar is good for them." What did they do a hundred years ago, when sugar was not known in Scotland? When I have done my level best to put my patients' teeth right, they deliberately undo all my attempts to save them. It is a clinical fact that we can, if we wish, prevent dental disease, and it could be taught to the student in one lecture. My point is, you can teach the student but you cannot teach the general practitioner.

Dr. Sillar.—When would the course of preventive medicine come in most valuably in the curriculum? Should it implement previous subjects or should it be taken very early in the curriculum in order to allow the basis of the problems which the student is, as it were, to have focussed in order that he should understand a great deal of the special instruction which he receives later. As an illustration, take the feeding of infants. I should like to know whether Dr. Robertson would suggest that this subject of infant feeding be taught by the professor of medicine or by the physiologist or the professor of clinical medicine.

Dr. Robertson.—I have no very hard-and-fast opinion on this subject at present, not yet having made out a syllabus for this course. But my first feeling is that one cannot possibly teach prevention until one knows the diseases one wants to prevent, so that I should have thought that prevention must follow very closely the ordinary course of medicine. Surely also that must be the case with regard to the prevention of diseases of infancy and childhood. The course on diseases of children might very well precede or run concurrently with the lectures on prevention of disease: the two ought to be very closely correlated. I do not see how you could take it as a course anterior, and therefore the position in the curriculum of preventive medicine would come very obviously in the third year. I agree that it would be a good idea to make these lectures spread over as long a time as possible, to make them as practical as possible, and to let the medical student see what can be done, among other things, in the proper rearing of infants and children. There is excellent material available for that. One sympathises with the difficulty of those who have to deal with very large classes. It is hopeless to demonstrate to more than thirty students at a time.

Dr. John Thomson.—With regard to the teaching of infant feeding, I might remind Dr. Sillar that it is only since the war began that the teaching of the diseases of children has been compulsory here, and I think he will find the general practitioners who have recently graduated are fairly well up in it. In the present course of diseases of children perhaps one-fifth of the lectures are given to the subject of feeding, and I hope that that may be increased in future.

Dr. J. S. Fowler.—I agree with Dr. Robertson that it would be an advantage to have preventive medicine studied more in the university. But the problem really is not wholly to bring it before the student in a more systematic way but also to extend to the poorer class the preventive medicine available to the well-to-do. A great step has been made in regard to children by the introduction of welfare centres. These centres are taking the same kind of preventive interest in the children of the poor that prevails in the better-class houses.

I agree that it is unnecessary to teach the student much of the Public Health he learns just now and that he should be rather taught to get into touch with the proper agencies as occasion demands.

Dr. Fleming.—In the therapeutics and clinical medicine of to-day I think a good deal of preventive teaching comes in, and I am not quite sure where the preventive teacher from the Public Health point of view is going to step in and take away from the medical and clinical teachers what they are attempting to do. I do not think, of course, that we give enough preventive teaching, and I think it is most useful to have the point impressed upon us. But I certainly think that in teaching fevers in the medicine course we try to take up the preventive side.

RECENT ADVANCES IN MEDICAL SCIENCE.

THERAPEUTICS.

UNDER THE CHARGE OF

JOHN ORR, M.D., F.R.C.P.

Oil of Chenopodium and Chloroform as Anthelmintics.

Hall and Foster publish a preliminary note (*Journ. Amer. Med. Assoc.*, 30th June 1917) on the use of oil of chenopodium and chloroform as anthelminties. The former is a volatile oil, official in the U. S. Pharmacopœia, and is derived from the chenopodium anthelmintica. It is very efficient in getting rid of ascarides, and the authors have made investigations in dogs and human beings to determine its exact effects. It has been found that chenopodium depresses the heart muscle, causes a fall of blood-pressure, decreases vagus irritability, and, what is important, inhibits peristalsis. It is thus a constipating substance, and, being so, is liable to be absorbed into the blood if it is not administered with a laxative. Accordingly, the authors find that it ought to be given with castor oil and followed by the same substance. Doses of 5 to 15 minims are recommended, with half an ounce of castor oil.

For the treatment of hookworms they have found chloroform decidedly superior to such a substance as thymol, and they administer this in 15 to 45 minims doses with castor oil. They recognise that care must be taken that the subjects to whom the chloroform is to be given must be free from renal or hepatic disease, and that the dose should not be repeated till an interval of two or three weeks has elapsed since the first dose was taken. But while chloroform has also a certain efficiency against ascarides, the authors do not consider that chloroform has any decided synergic action when administered with chenopodium. They state, however, that as the two forms of parasite sometimes co-exist, there may be an advantage in combining the two remedies to meet the concurrence in the same patient of the two classes of worms.

Chaulmoogra Oil in Leprosy.

Chaulmoogra oil (oleum gynocardiæ) has long been employed by oral administration and by inunction for the treatment of leprosy and tuberculosis, but has met with only moderate success. It is now recommended for hypodermic administration by Bercovitz (*Journ. Amer. Med. Assoc.*, 30th June 1917). Heiser has already published a formula suitable for hypodermic use, consisting of ol. gynocard. 60 c.c., camphorated olive oil 60 c.c., and resorcin 4 grms. Of this mixture 1 c.c. is injected after sterilisation under the skin of the arms or legs at

intervals of a week, increasing the dose gradually till 3 c.c. are being injected at a time. A slight general reaction may occur but is evanescent, and no local reaction has been observed. Weekly injections are given for nine months. After a month patients have expressed themselves as feeling in better health; increase in weight has occurred, and after some months cases of the anæsthetic type have begun to complain of pains in the affected parts, and there has been some return in tactile sense. Tubercles get smaller and some disappear, while painless ulcers heal and become painfully sensitive. Tubercles have been excised after some months' treatment and have been found to show evidence of degeneration of epithelioid cells and commencing fibrosis. Bacilli have still been detected in such cases however.

The author presents this as a preliminary note, and promises further information later, as his experience increases, of this method of treatment.

Nikalgin.

Nikalgin is the name of a new anodyne and local anæsthetic whose exact constitution, source, and mode of preparation are at present unknown. Probably it is in the main quinine urea hydrochloride. Whatever it be, its action in allaying the sensitiveness of painful surfaces is very powerful, and it is being used largely in the war zones. Like other substances, secret at first, its composition will ere long be published (*Med. Record*, 29th September 1917).

Treatment of Goitre.

Sheehan (*Med. Record*, 6th October 1917) revives an old method of treatment for goitre, both of fibrous and exophthalmic type. He cites a series of cases, mainly of the simple fibrous variety, in whom he has injected 4 drops of equal parts of carbolic acid, tinct. iodi., and glycerine at five-day intervals. He claims that he has in every case removed all the pressure symptoms, obtained diminution and sometimes disappearance of the swelling, and in exophthalmic cases has secured abolition of all symptoms and physical signs, save tachycardia. No bad effects have been noted, such as have occasionally been described by other clinicians, and he advocates that arsenic and phosphates in some form be administered during the course of treatment. While he has found five injections to suffice in most of his cases, he says that in more resistant cases there is no objection attaching to the prolongation of the injections for a longer period.

Continuous Bath in Delirium.

The continuous bath treatment in mental disease is the subject of a paper by Strecker (*Journ. Amer. Med. Assoc.*, 16th June 1917), who

has used this form of treatment in cases of delirium of various types, including delirium tremens, and is strong in its favour. He is of opinion that it is superior to and safer than the routine use of hypnotics, and does not fail to insist on the necessity for careful watching of the patient while the continuous bath is in operation. His testimony to the good effect of this method is in accordance with the experience of Kraepelin, who has long employed hot baths of running water in the handling of cases of acute mania. For many years this form of dealing with these acute mental cases has been in operation in Munich, especially in the clinic for incipient insanity cases and acute mental disorders.

Thymol in Trichinosis.

Thymol treatment of trichinosis is dealt with by Kahn (*New York Med. Journ.*, 16th June 1917). When the parasite has left the alimentary canal and has lodged in the muscles, it is necessary to reach it through the blood-stream. In the alimentary canal thymol attacks the parasite with success, but after absorption it undergoes alterations in the liver. If thymol be introduced directly into the blood-stream this action on it by the liver does not take place so readily, and similarly if administered intramuscularly. Fifty grs. of thymol are dissolved in 50 c.c. of sterilised olive oil, and 2 or 3 c.c. of this solution are injected into a muscle daily for seven days. These injections cease for a week and are resumed. No toxic effects have been observed, and many of the symptoms of trichinosis have been shown to disappear, such as muscular pains, swelling of the eyelids and face; while showers of eosinophile leucocytes appear in the urine. Kahn suggests, although he has so far not yet tried, the employment of this method of using thymol in cysticercus, filaria, and echinococcus invasions.

Mineral Oil as a Vehicle.

Hoelscher publishes a preliminary report concerning this subject (*Therapeutic Gazette*, 15th October 1917). He alludes to the fact that the paraffin oils do not undergo absorption from the alimentary canal but are excreted unchanged, no part of them being taken into the general circulation. He proposes to make use of this fact in the treatment of intestinal fermentation by antiseptic substances dissolved in this medium, securing intimate contact of the antiseptic with the putrefactive agencies and at the same time no absorption into the blood. He has accordingly tried iodine in strength of 1 gr. in 2 ozs. of the mineral oil, and giving half an ounce once or twice daily. His conclusions are that no iodine reaches the blood, even when the petrolated oil is taken for several months, and on no occasion has any sign of iodism appeared; that the iodine does not interfere with the laxative action of the oil; that the effect on the intestinal putrefaction is bene-

ficial, and the patient's symptoms are decidedly ameliorated or abolished.

He has added in certain cases of colitis bismuth subcarbonate, with a beneficial effect as regards the colitis.

Drug Habituation and Drug Psychoses.

Leahy contributes a lengthy paper (*Long Island Med. Journ.*, October 1917) in which he deals fairly comprehensively with this subject. Much of what he writes is not new, but his remarks are well timed at the present day. Dealing with opium and its derivatives, he thinks that heroin is the alkaloidal compound mostly employed by morphinomaniacs of to-day, and that in a large proportion of cases it is taken as a snuff, although, of course, he recognises that it is also taken hypodermically. There is some reason to think that the employment of heroin after abdominal operations may be the introduction of the patient to this drug; and, if this be so, it is incumbent on medical men and surgeons to exercise the greatest circumspection in employing this potent substance. The author rightly holds that cases which have undergone a "cure" are very liable to lapse into the bad habit after getting back to ordinary life. Speaking of the cocaine habit, it is pointed out that it may be added to the morphine habit—an already well-known fact—but he does not allude, save in a cursory fashion, to the important symptom of sensation of foreign bodies under the skin, which is such a valuable clue to the detection of cases of cocaine habit at a comparatively early stage. The author believes that most drug habitués are abnormal people to begin with, and that their mental subnormality militates against their curability. One is inclined to join issue with the author on this point, as one often finds that drug habitués are people of over-average brain power and mental attainments. Treatment in a farm colony is advised, with plenty of manual work and fresh air, and he suggests a three-year course of treatment for cocaine cases. Few medical men who have seen the course of cocaine cases will refuse to subscribe to this suggestion, as small indeed is the percentage of recoveries in the true sense of the term.

Treatment of Bronchial Asthma by Vaccines.

Sicard (*Amer. Journ. Med. Sci.*, June 1917) is very optimistic as to the effects of vaccine therapy in this condition. He traces the analogy between asthma and some of the manifestations of anaphylaxis and criticises the so called reflex causes of asthma, such as nasal polypi. These he regards as interfering with the drainage of the accessory sinuses and permitting absorption of products, which would escape but for the presence of the polyps, whose removal may effect a cure by re-establishing free drainage. Bacterial causes of asthma have much

engaged his attention, primarily streptococcus viridans and hæmolyticus, with micrococcus catarrhalis acting secondarily. The author believes that an autogenous vaccine will cure these cases. Beginning with 100 million in adults he gives larger doses as such appear to be needed, observing carefully for local reaction, which ought not to be too severe if the right dosage is being employed. Too severe local or general reaction calls for a halt for a time. Doses of 1000 million are often all that may be required, but in protracted or refractory cases he proceeds to 2000 and even 3000 million. Sicard believes the streptococci to be the chief offenders, and that nearly all cases are susceptible of cure. Inoculations are made at semi-weekly or weekly intervals.

NEW BOOKS.

Nerve Wounds. By J. TINEL, ancien chef de clinique de la Salpêtrière. Translated by FRED ROTHWELL, B.A., London. Revised and edited by CECIL A. JOLL, M.B., F.R.C.S., Senior Surgeon, Richmond Military Hospital. Pp. 317. With 323 Illustrations. London: Baillière, Tindall & Cox. 1917. Price 15s. net.

THIS book presents the results of investigations carried out in the Charcot clinic by Déjerine and his pupils (of whom Tinel is one), and the author is deservedly praised by Déjerine for the high standard he has aimed at and succeeded in attaining. While the work of Waller, Duchenne, Weir Mitchell, Broca, Lejars and others on lesions of the peripheral nerves is mentioned in the introduction, there is the curious omission of any reference to the observations of Head and of Sherren, both of whom we have come to regard as authorities on the subject in this country.

Very distinct differences are drawn of the clinical picture and the prognosis in injuries which are anatomically complete and those which are incomplete; paradoxically, symptoms and outlook are liable to be infinitely worse where the lesion is incomplete. Trophic changes are stated never to be prominent in complete section of a nerve; at the most they are characterised by a cyanotic coloration of the skin, and by a loss of character in the skin which desquamates in a fine, branny form. Marked trophic changes always indicate an incomplete interruption of the nerve, and they are met with not only in the skin but in all tissues of the limb, even including the bones; tendon sheaths become fixed to the tendons, and permanent changes take place in joints that seriously compromise the prognosis. Further, instead of the anæsthesia associated with complete division, the muscle bellies are tender, as is also the trunk of the nerve, and its cutaneous area is

either the seat of "painful hypo-anæsthesia" or of "acute hyperæsthesia." In complete lesions the muscles are in flaccid paralysis; in incomplete ones they may be in a state of tone, or even of hypertone, producing deformity not in keeping with the accepted type, or, it may be, exaggerating this.

Causalgia is described as a special type of irritation met with in incomplete lesions; as a rule there is an absence of paralysis or of extensive trophic changes, but there is an acute hyperæsthesia extending beyond the ordinary confines of the nerve, and there are vasomotor changes. The view is expressed that it is a neuritis of the sympathetic fibres that accompany the vessels, and some benefit is said to have resulted from denuding the brachial artery of the sympathetic plexus.

In a lesion of a mixed nerve great emphasis is laid on the phenomena of "tingling" in the area of cutaneous distribution. If it can only be elicited by pressure at the seat of lesion, it means that the axis cylinders have got no further and that regeneration is not taking place; if it can be elicited below the lesion, it implies regeneration and advance on the part of the young axis cylinders. This test of regeneration is at the same time the most trustworthy and the earliest applicable.

Part I. concludes with the general diagnosis of peripheral nerve lesions; it is expected that this will aim at giving the nerve that has been injured, the site and also the extent of the injury, whether complete or incomplete, and to indicate, in the case of the latter, whether mere liberation or resection is to be preferred.

Part II. is concerned with the lesions of the individual nerves of the upper limb, and Part III. with those of the nerves of the lower limb; Part IV. deals with conclusions, including two chapters, one on surgical and another on electrical treatment. There is a large number of excellent photographs and diagrams.

It may be inferred, from the account of this book which we have given above, that it deals with the injuries of nerves in the most comprehensive and thorough manner, and that the reader will find in it a veritable mine of information.

The Battle with Tuberculosis and How to Win it. A Book for the Patient and his Friends. By D. MacDougall King, M.B. Pp. 258. Philadelphia and London: J. B. Lippincott Co. 1917. Price 6s. net.

This is a book especially addressed to tuberculous patients by a doctor who himself has passed through the anxious and trying experience of treatment for pulmonary tuberculosis. If it is a little longer than some would like, and if, here and there, things might be said with less circumlocution, it possesses the great advantage which experience alone

can give. The author has realised what so many doctors and patients and friends of patients fail to discover, that the downward pathway in tuberculosis is largely the resultant, on the one hand, of failure to comprehend the natural history of the disease and the rationale of successful treatment, and, on the other, of lack of patience and constancy in following the necessary line of treatment. Doctors in charge of cases will find in the book not a little that will prove of interest and value to themselves. By placing it in the hands of thoughtful patients they will probably lighten and shorten the road to recovery and at the same time remove some of the misunderstandings which may embarrass the relations between doctor and patient in so protracted an illness.

NEW EDITIONS.

The Encyclopædia Medica. Edited by J. W. Ballantyne, M.D. Second Edition. Vol. V. Pp. viii. + 766. Edinburgh: W. Green & Son, Ltd. 1917. Price 20s. net.

This volume of the *Encyclopædia* comprises the rubrics from Filix mas to Heart, and includes forty-two major articles, along with a great many shorter notes and definitions. All of the longer articles have been very thoroughly revised, or in a few cases rewritten either by the original authors or by new contributors. There are new articles on the anatomy and development of the fœtus, and on gynecological diagnosis, from the pen of the editor, and on the examination of the heart by graphic methods by Captain G. D. Mathewson. The former article on gout has been replaced by a new one by Major Alex. Goodall, and that on gas gangrene has been rewritten by Professor Alexis Thomson. The subject of "gassing" is somewhat shortly dealt with in another article in which the literature of the subject is summarised. Probably more material for a complete account of the action of poisonous gases on man will become available later, and the subject is one which might well be dealt with in a future volume. For the numerous notes on drugs Dr. John Orr is responsible. Space forbids our making more than a general reference to the excellencies of this volume, but no one who possesses it can fail to notice the care which Dr. Ballantyne has exercised in selecting his staff of contributors, and the faithful way in which they have fulfilled their allotted duties. That it should be possible to produce successive volumes of the *Encyclopædia Medica* in the face of all the difficulties created by the war is in itself noteworthy; that the standard of the earlier, pre-war, volumes should have been so fully maintained as it is speaks highly both for the industry of the editor and the enterprise of the publisher.

Radiography and Radio-Therapeutics. By ROBERT KNOX, M.D. Second Edition. Vol. I. Radiography. Pp. xxv. + 384. With 490 Illustrations. London: A. & C. Black, Ltd. 1917. Price 30s. net.

DR. KNOX is to be congratulated on the second edition of this book, which is by far the best work on the subject in the English language, and unsurpassed in its particular line for originality. The monograph is most comprehensive, and practically everything of real importance bearing on the subject is fully considered.

Following on an exhaustive chapter on the installations necessary for X-ray work is a very clear and concise account of stereoscopic radiography and a valuable contribution to the localisation of foreign bodies. The author supplies a long-felt want in dealing with normal bones and joints, a knowledge of which is so essential before an opinion can be formed of abnormal conditions, and in this connection the description of the skull and accessory sinuses will be found to be both interesting and enlightening. No less welcome are the very full accounts of the examination of the thorax and its contents, the examination of the alimentary canal, and the radiography of the urinary tract.

The outstanding feature of the book is the illustrations. They are all excellent, carefully selected, and, from an educational point of view, must prove of great assistance in reading and interpreting radiographs. Very remarkable negative and positive pictures are shown side by side, thereby bringing out details and contrast.

The general arrangement of the book leaves nothing to be desired, and the simplicity of the writing makes it easy to understand and a pleasure to read. Radiography, as a handmaid to medicine and surgery, is becoming of increasing help and importance, and Dr. Knox emphasises this fact clearly and strongly. Both to those engaged actively in radiography, as well as to the student, we can confidently recommend this volume as a valuable and reliable contribution.

Tropical Diseases. By Sir PATRICK MANSON. Sixth Edition. Pp. xxii. + 968. London: Cassell & Co., Ltd. 1917. Price 16s. net.

MANSON'S *Manual of Tropical Diseases* is so well established a standard text-book as hardly to require any commendation. The features which have distinguished it in the past are still maintained; it is essentially a practitioner's manual, and clinical diagnosis and treatment occupy a prominent position throughout. Since the fifth edition was reviewed in this column some three years ago a number of advances have been made in tropical medicine, and the chief of these find a place in the new edition. In reviewing a book of this kind—indeed a book of

almost any kind—one's thoughts naturally turn to its usefulness in war, and from that point of view we can recommend it to those who are attached as medical officers to our armies in the East. So far as military medicine is concerned, it is perhaps regrettable that the subject of typhoid is very briefly referred to and paratyphoid is not mentioned at all, but of course, although these diseases are common in the tropics, they are scarcely "tropical diseases" in the narrower sense. The war has produced a great deal of valuable work on tropical pathology and preventive medicine. Some of this has been incorporated in Manson's book, and it is to be hoped that when the next edition is called for the coming of peace will have made the rest available.

A Manual of Medicine. By T. K. MONRO, M.D. Fourth Edition. Pp. xxiv. + 1045. London: Baillière, Tindall & Cox. 1917. Price 18s. net.

IN a review of the first edition of this text-book, now a good many years ago, it was prophesied that the work would prove both useful and popular. Time has verified the prediction, and we are sure that the fourth edition, which has been very thoroughly revised and is a comprehensive student's text-book of modern medicine, will prove invaluable to those working for the final examination. It is a model of what a good text-book should be and a worthy member of the publishers' "University Series."

Diseases of the Throat, Nose, and Ear. By WILLIAM LAMB. Fourth Edition. Pp. xi. + 372. With 51 Illustrations. London: Baillière, Tindall & Cox. 1917. Price 8s. 6d. net.

THE fourth edition of this guide has been carefully revised and brought up to date, so that it will continue to hold its place as one of the leading elementary text-books. The sections on diagnosis are eminently practical, and, as might be expected from a writer of such ripe experience, the directions regarding treatment are clear and concise. Recent developments, such as the labyrinth tests, intranasal operation on the frontal sinus, tonsil enucleation, receive due consideration, though all laryngologists will not agree with the author in his choice of the Sluder method of tonsillectomy in preference to the Whillis operation. The photographs and diagrams to illustrate various anatomical facts are an attractive feature of the book. Those illustrations are specially welcome in relation to nasal sinus suppuration, though here a greater reference to radiography would not have come amiss. There is a timely note on the treatment of otitis in fever hospitals. The volume is of handy size, well printed, and full of sound teaching, and it may be confidently commended to students and junior practitioners.

Genito-Urinary Surgery and Venereal Diseases. By EDWARD MARTIN, A.M., M.D., F.A.C.S.; B. A. THOMAS, A.M., M.D., F.A.C.S.; and S. W. MOORHEAD, M.D., F.A.C.S. Tenth Edition. Pp. xxiv. + 929. With 443 Illustrations. Philadelphia and London: J. B. Lippincott Co. 1917. Price 30s.

THIS edition represents practically a new work, the whole book having been rewritten and reset and brought thoroughly up to date. The pathological conditions are carefully described and freely illustrated, and a large amount of space is given up to full and detailed descriptions of methods of diagnosis and treatment. It is essentially a practical work, and therein lies its chief merit. The section dealing with the examination of the urine and renal function is short but comprehensive, that on the surgery of the testicles very complete and well illustrated. A particularly well-written chapter is that on the surgery of the prostate and the predilection exhibited for the perineal operation of prostatectomy, but reflects the opinion of American surgeons.

Rather more than one-third of the book is given up to venereal diseases, and the chapters on gonorrhœa and syphilis are full of sound practical instruction and well repay study. All the clinical methods of diagnosis are clearly and carefully described, and detailed descriptions of treatment, which take nothing for granted, form a valuable feature of this part of the book.

Throughout the book the writing is direct and succinct, the illustrations are particularly good and almost without exception informative. Plate XX., said to illustrate the spirochæta pallida, is an exception and somewhat of a puzzle. To all who wish a practical book on genito-urinary surgery or venereal diseases this volume may be strongly recommended.

A Text-Book of the Practice of Medicine. By JAMES M. ANDERS, M.D., Ph.D., LL.D., and JOHN H. MUSSER, Jr., M.D., University of Pennsylvania. Thirteenth Edition. Pp. 1259. Illustrated. Philadelphia and London: W. B. Saunders Co. 1917. Price 25s. net.

THE present edition of this well-known text-book is the product of a thorough revision of the twelfth issue. Much new matter has been added on the treatment of acidosis, tetanus, on the etiology of aortic incompetency, the estimation of renal function, anaphylaxis of food intoxication, the pneumococcic infections, focal sepsis, functional tests of hepatic insufficiency, etc. Many other important subjects have been recast, and the section on nervous diseases has been practically rewritten. The description of certain complaints whose incidence has materially declined have been abridged without any impairment of the

intrinsic value of the book. A few diagnostic tables have been added. The proofs of the new matter have not been very carefully corrected. The illustrations are good. The work can be recommended as a reliable and thoroughly modern text-book of medicine for students and practitioners.

Green's Manual of Pathology and Morbid Anatomy. Twelfth Edition. Revised by W. CECIL BOSANQUET, M.A., M.D.(Oxon.), F.R.C.P. (Lond.), and W. W. C. TOPLEY, M.B., B.C.(Cantab.), M.R.C.P. (Lond.). Pp. viii. + 603. With 247 Illustrations. London: Baillière, Tindall & Cox. 1918. Price 18s.

Green's Manual of Pathology and Morbid Anatomy has, with the present issue, reached the twelfth edition. It attempts, within the limits of a volume of 600 pages, to give the student of medicine an introduction to the principles of pathology. This retains for the most part the form of the earlier editions. The book has been kept up to date, and valuable new matter has been added to the chapters on blood disease and immunity. The chief difficulty before the authors is to include within the dimensions of the volume more than a mere outline of the various subjects. The last section of the book—on diseases of the nervous system—is a striking example of how much can be done in this respect, even when the limitations of space are so stringent.

The Conduction of Nervous Impulses. By KEITH LUCAS, Sc.D., F.R.S. Revised by E. D. ADRIAN, M.B., M.R.C.P. With Diagrams. London: Longmans, Green & Co. 1917. Price 5s. net.

KEITH LUCAS was killed in an aeroplane accident on 5th October 1916. In the words of Professor Starling, the editor of this series of monographs, "his loss to the Flying Corps is as great as his loss to physiology, for from the beginning of the war he applied all his inventive faculties to solving the practical problems which confront our aviators."

One of the most brilliant of British physiologists, Keith Lucas's name will always be remembered in connection with the question of nerve conduction. The work under review comprises the substance of a series of seven lectures delivered at University College in 1914, in which the author summarises his researches upon this most difficult subject, marshals the evidence as to how a nerve conducts, and indicates how far the phenomena of conduction in a peripheral nerve may be made the basis of the understanding of conduction in the central nervous system. The reviser, who collaborated with the author in several of his researches, and who was familiar with his views, has rewritten two of the chapters which were incomplete.

A Short Practice of Midwifery. By HENRY JELLETT, B.A., M.D. Seventh Edition. Pp. xvi. + 545. With 240 Illustrations. London: J. & A. Churchill. 1918. Price 12s. 6d. net.

A BOOK which has entered its seventh edition, and of which twenty-four thousand copies have been sold, requires no words to recommend it, and defies criticism. Such is Jellett's *Midwifery.* It embodies the treatment adopted in the Rotunda Hospital, Dublin, and appears with a blessing from Sir W. J. Smyly. It is justly popular, as it is simply and clearly written, so that any student may comprehend what is intended, while the text is amplified by numerous excellent and instructive illustrations.

It is always practical, and would make a valuable *vade mecum* for any general practitioner who wishes to know in a few words what to do in any particular emergency.

Collected Papers on Analytical Psychology. By C. G. JUNG. Authorised Translation. Edited by Dr. CONSTANCE E. LONG. Second Edition. Pp. xxviii. + 492. London: Baillière, Tindall & Cox. 1917. Price 15s. net.

TWO new chapters are added to this edition. The first contains an epitome of the whole field of analytical psychology.

Freud's view of the repressed sex origin of the neuroses, its value for the understanding of their nature, and its limitations as a therapeutic agent, are succinctly described.

Next comes a good description of Adler's "will to power" theory whereby the neurosis is regarded as a "convenient arrangement"—an unconscious one, of course. Thus a woman feels she is losing power over her husband, she develops a neurosis, and this in many cases brings him back to interest in her, if not to love.

Jung breaks away from the Vienna school in accepting this and even other origins of neurosis; and though the above instance has to do with a sex matter, the departure is real enough, for it might have happened equally well if a woman thought that some old servant was not paying her enough attention. Jung observes two types of human psychology—an introvert type, where thought is highly developed and feeling infantile; an extrovert, where the conditions are reversed. The will to power theory fits the first, the repressed sexual the second.

This portion of the book is most interesting, and the idea seems just and helpful.

But Jung has discovered the not very surprising fact that finding the cause of a disease is not identical with curing it. The problem that remains is what to do with the psychic energy that is available after it has been freed from the complex. Good works do not satisfy everybody. And though the complexes have all been cleared, the

patient still has a troublesome unconscious. What is this, and what is to be done with it? This unconscious is not personal, but is the common unconscious we have all inherited. In it lie the ideas about God, religion, magic, devils, and such universals. At one time religion would have helped; but the problem about God "is an absurd problem," and yet the idea is a psychological necessity. Jung seems from the bulk of pages, to have a solution, but to us it is incomprehensible.

NOTES ON BOOKS.

Field Sanitation, by C. G. Moore, Capt. R.A.M.C., and E. A. Cooper, Capt. R.A.M.C. (Baillière, Tindall & Cox, 1918). The authors of this handbook have produced a thoroughly practical account of all branches of sanitary work in the field. There could be no better supplement to the official Field Service Regulations on this part of the Army Medical Service's work. There are numerous clearly drawn plans and diagrams, and of especial interest are the chapters dealing with constructive work (brickwork, wooden huts, etc.), economy, and the organisation and functions of sanitary companies. The book would be of value to many regimental, as well as medical, officers at the present time.

The Theory and Practice of Massage, by Beatrice M. Goodall-Copestake (H. K. Lewis & Co., Ltd., price 8s. 6d.), should prove very valuable, both as a text-book for the student of massage and as a book of reference to those already trained. It is well arranged, and illustrated by clear, well-taken photographs. The chapters on fractures and on active and passive movements should be specially helpful for those masseuses doing military work.

Asthma, by Orville Harry Brown (Henry Kimpton, 1917), is based upon an extensive study of the asthma problem, which has led the author to the conclusion that the essential feature of the disease is "non-passive expiration." This theory he has fully elaborated in a book which contains much good teaching and sound argument. The result of long and painstaking research, the writer's views are well worthy of careful consideration by every physician.

Chemistry for Beginners, by C. T. Kingzett, F.I.C., F.C.S. (Baillière, Tindall & Cox, second edition, price 2s. 6d.), whilst not of much use to the serious student of chemistry, will serve a useful purpose in arousing interest in chemical science in a schoolboy or general reader. It is written in a clear and popular style, and a glossary of scientific terms forms a useful appendix to the work.

BOOKS RECEIVED.

ADAMI, J. G. Medical Contributions to the Study of Evolution . . (*Duckworth & Co.*) —
BAYLISS, W. M. Principles of General Physiology . . . (*Longmans, Green & Co.*) 24s.
BROWNING, C. H. Applied Bacteriology . (*Henry Frowde, and Hodder & Stoughton*) 7s. 6d.
CARREL, A., and G. DEHELLY. Translated by Herbert Child. Infected Wounds. Second Edition . . . . (*Bailliere, Tindall & Cox*) 6s.
CARTER, HERBERT S., PAUL E. HOWE, and HOWARD H. MASON. Nutrition and Clinical Dietetics . . . . (*Lea & Febiger*) dols. 5.50
CUSHING, HARVEY. Tumours of the Nervus Acusticus. Third Edition. (*W. B. Saunders Co.*) —
DAKIN, HENRY DRYSDALE, and EDWARD KELLOGG DUNHAM. Handbook of Antiseptics. (*Macmillan & Co., Ltd.*) 7s.
DRUMMOND, W. B. Dent's Medical Dictionary . . . . (*J. M. Dent & Sons, Ltd.*) 10s. 6d.
GREEN, A. RUSSELL. X-Ray Atlas of the Skull . . . . (*Longmans, Green & Co.*) 10s. 6d.
HIRST, BARTON COOKE. A Text-Book of Obstetrics. Eighth Edition. (*W. B. Saunders Co.*) 21s.
JOHNSON, CECIL WEBB. Painless Childbirth in Twilight Sleep in the East. (*Butterworth & Co. (India) Ltd.*) Rs. 4.
KERLEY, CHARLES GILMORE. The Practice of Pediatrics. Second Edition (*W. B. Saunders Co.*) 28s.
KNOX, ROBERT. Radiography and Radio-Therapeutics. Vol. II. . (*A. & C. Black, Ltd.*) 15s.
KOLMER, JOHN A. Infection, Immunity, and Specific Therapy. Second Edition (*W. B. Saunders Co.*) 30s.
LEWIS, THOMAS. Clinical Disorders of the Heart-Beat. Fourth Edition (*Shaw & Sons*) 6s.
LOCKYER, CUTHBERT. Fibroids and Allied Tumours . . . (*Macmillan & Co., Ltd.*) 63s.
LUSK, GRAHAM. Food in War Time . . . . (*W. B. Saunders Co.*) 2s. 6d.
MACKENZIE, Sir JAMES. Symptoms and their Interpretation. Third Edition. (*Shaw & Sons*) 8s. 6d.
MALONEY, WM. J. M. A. Locomotor Ataxia . . . . . . (*D. Appleton & Co.*) 15s.
MOYNIHAN, Sir BERKELEY. American Addresses on War Surgery (*W. B. Saunders Co.*) 7s. 6d.
PAUL, C. NORMAN. The Influence of Sunlight in the Production of Cancer of the Skin. (*H. K. Lewis & Co., Ltd.*) 10s. 6d.
QUENU, E. Plaies du Pied et du Cou-de-Pied . . . . (*Librairie Felix Alcan*) frs. 16.50
STOKES, JOHN H. The Third Great Plague . . . . . . (*W. B. Saunders Co.*) 6s. 6d.
SUTTON, EDWARD. Fitting Out and Administration of a Naval Hospital Ship. (*John Wright & Sons, Ltd., Bristol*) 8s.
TIBBETTS, T. M. The Panel Doctor . . . . (*John Bale, Sons & Danielsson, Ltd.*) 2s. 6d.
TRANSACTIONS of the American Pediatric Society (Twenty-ninth Session). Edited by Oscar M. Schloss . . . . —
WENYON, C. M. and F. W. O'CONNOR. Human Intestinal Protozoa in the Near East. (*Wellcome Bureau of Scientific Research*) 10s. 6d.
WILEY, HARVEY W. Foods and their Adulteration. Third Edition . (*J. & A. Churchill*) —
YEALLAND, LEWIS R. Hysterical Disorders of Warfare . . (*Macmillan & Co., Ltd.*) 7s. 6d.

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(*Abs.*) = Abstract. (*Ed.*) = Editorial Note.

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